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THE PRACTICAL TEACHER

Professor MICHAEL SADLER.

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EDUCATION IN PARLIAMENT:

HUNG UP.

THE Education Bill is hung up, like a piece of venison, to mellow; it is suspended from a hook somewhere in the cellars of the House of Lords. After three days of full-dress debate, the Peers Spiritual and Temporal let the measure get a Second Reading without a division, and then with joy "broke up" and departed to their various estates and mansions within the three kingdoms. "Committee when we come back," said they. "You are to come back at the end of October," said Lord Ripon, leader and captain of sixty Liberal peers. So the Bill is to hang and mellow until October is nearly gone.

It will then be ready for cooking, and to all appearances it will be done brown. Raw or semi-raw legislation is a thing abhorrent to the Peers, and the Education Bill is so very new that it can hardly be other than raw. Four months it occupied the cooks in the House of Commons, but what of that? The cooks in the House of Commons do not wear the *cordon bleu*. Lord Halifax has a very poor opinion of some of them. In the House of Lords he quoted from one of them, Mr. Herbert Paul, but "I ask your Lordships' pardon for mentioning such a person," quoth he. Such is the disdain of Lord Halifax, leader of High Church laymen, for the successor of Mr. Labouchere. It is true that Mr. Paul had referred to the Bishop of London as "the most innocent creature on God's earth," but that might well be regarded as a compliment. Ought not a Bishop to be innocent indeed?

But these are the amenities which the Education Bill has bred. Education is a hedgehoggy, porcupiny subject, with a spine for the hand of each person who tackles it, no matter how many. The spine in Dr. Macnamara's hand (which has tackled the subject often) was to be accused (by Mr. Cox, who represents that educational centre, Preston) of talking about the children, but thinking about the teachers all the time. Another Lancashire member, Mr. Ryland Adkins, has been rather spiny towards teachers also. To the philosopher it is amusing, but to less calm persons somewhat irritating, to find electoral and popular representation purists like Mr. Cox and Mr. Adkins become so anxious for the voluntary school system to be perpetuated, directly they come to sit for constituencies where there are a good many voluntary schools. But—"what a piece of work is man!"

The Duke of Devonshire, too—once the President of the Board of Education, and of the Association for Technical and Secondary Education also—was almost as severe as Lord Halifax on the Bill and the authors of its being. The 30th day of July Mr. Birrell ended the House of Commons debates on the Bill (for the present) with a speech of fire and eloquence, humour and pathos; saw Little Bill, his Parliamentary progeny, safely through the last division lobby; and then took the little fellow, toddling along, up to the House of Lords. On the 1st day of August the Peers began to threaten to deal with Little Billee as Gorging Jack and Guzzling Jimmy did in Thackeray's ballad, when "Jack took out his snickersee." The Archbishop of Canterbury's attitude towards Little Billee was one of Christian fortitude in the midst of sore and unjustifiable trial, but Lord Halifax and the Duke of Devonshire took up a melodramatic stand, saying (as it were) with their gleaming blue snickersees ready in their hands—

"Undo the buzzum of your chimee!"

But there were thirty Bishops present, and some of them intervened (as the Archbishop did also) to prevent this sudden massacre of the innocent. As an innocent himself (teste Mr. Paul) the Bishop of London intervened sympathetically, and the young life was spared for the present. But there are more ways of

killing a dog than by hanging him. The Primate of All England indicated a way. The Most Reverend Primate, as his fellow-peers style that worthy and common-sensible man, during the course of the best speech he ever made in his life, pointed out at least ten cardinal amendments which the House of Lords might make to the Bill. The total effect of the ten, or of any five, or of a particular two or three of them, would be the death of Little Billee when he gets back to the House of Commons. But it is very doubtful whether the Lords will transmogrify Little Billee quite as much as the Primate in outline proposed; yet beyond any shadow of a doubt transmogrify him they will.

When the time comes for him to toddle back to the Lower House his best friends will hardly know him. They will be reminded of what was done (not by a peer but to a peer) in the case of Gwynplaine in "L'Homme qui rit." Cries of surprise will greet his abashed appearance in the House of Commons. He will somewhat resemble the old woman in the folksong, when they "cut off her petticoats round about." He will enter the House of Commons shyly, doubtful whether he is really he. And then the hubbub will begin.

That is prophecy, and a different anticipation is quite allowable. Lord Chancellor Robert Reid (less well known as Lord Loreburn) promised a fair and tolerant hearing by the Government for any noble lord's amendments, and Lord Lansdowne also took up a moderate line. In the Archbishop's speech, too, a keen ear might catch a deprecatory note, a sound of doleful anxiousness lest there would be no great fight put up, and lest in the long run the Act might be very much what it now is in the cocoon of a Bill. Quite likely, indeed, that after repudiation of most of the Peers' amendments, and adoption of some of them, in the House of Commons, the Peers may consent to the abandonment of much of their handiwork after all. At any rate, the Bill, in certain important parts of it, is likely to be temporarily so changed that it does not appear worth while to dwell in detail on the alterations recently made in it in the House of Commons.

But there is one change, of import to teachers, which ought to be mentioned. In its first form the Bill made some slight provision for the case of teachers employed in schools which will not be transferred to the local authority and not be continuously carried on. The provision was to allow such teachers, while out of employment, to pay to the Superannuation Annuity Fund and claim recorded service (while in no service) for the space of a year. That was, of course, absurdly inadequate. The case of voluntary school teachers in a school which *is* transferred is properly guarded; they are to be transferred with the school, and to suffer no loss in status or emoluments. But what about the others?

Dr. Macnamara and Mr. Yoxall summoned a meeting of members about the case of the dispossessed teachers, and a large and influential meeting it was. Then the two, with Sir W. Anson, Lord Balcarres, Mr. Arnold-Forster, Mr. Maddison, and Sir Henry Craik, went to the Board of Education about the matter, and presently a new clause was added to the Bill. By this clause the local authority is to compensate a teacher thrown out of employ by the non-continuance of a voluntary school as a public elementary school, if, "having used due diligence," he or she fails to obtain employment elsewhere, or finds it at a reduced stipend only. In the former case, compensation of not more than three years' salary is payable; in the second case, of not more than three times the difference in the salary. This is not much, perhaps, but it is something; and without the presence of Dr. Macnamara and Mr. Yoxall in the House of Commons, it would have been nothing at all. Moreover, the one year's recorded service at first promised is to be changed into three.

That is a clause which the Lords are unlikely to alter; it is doubtful whether constitutionally they can touch it, because it involves finance, and finance (national finance at any rate) lies within the prerogative of the House of Commons alone. But the Lords may be expected to "make clause 4 mandatory"—that is to say, that where an urban denominational school consists of children whose parents, to the extent of four-fifths of the children, desire that their children may continue to receive the denominational instruction now given, then it shall not be "may" but "shall," the local authority losing any option in the matter. Probably the "urban district" (of 5000 population or more) will be so altered as to include for this purpose any smaller district in which there is also an undenominational school. And the teachers, who are allowed to volunteer to give denominational instruction in the four-fifths schools, will be allowed to volunteer for it in any school, if the Lords get their way in the matter, irrespective of locality or school.

Then the Council for Wales, which the Bill sets up, will probably be knocked down by the skittle players in that sumptuous alley, the Gilded Chamber. And probably the "right of entry" by the Bill at present accorded in transferred voluntary schools will be extended to any school anywhere (Council schools included) by representatives of any denomination. Now this particular amendment would, if persisted in, mean the abandonment of the Bill.

If in the last resort, all forms of conciliatory process failing, the Bill is abandoned, it means the postponement for two or three years of a Scotch Education Bill. The Lord Advocate is to be busy with other than Scotch Education Bills next year. It will mean the postponement of other matters affecting teachers also—the Codification of Education Acts Bill, and any present prospect of a Teachers' Superannuation Act Amendment Bill. There is reason to wish and pray, therefore, that the Bill may not be *too* transmogrified in the House of Lords, and that the Government and the House of Commons may not be *too* stiff and unbending when Little Billee comes toddling back disguised. For the present he is having holiday, while praters cease from troubling and reporters of education in Parliament are at rest.

The National Home Reading Union.—We have received the report of the Union for 1906, and offer our congratulations on the success of its work. It seems that the number of members has increased by nearly 6000, and that the circular issued by the Board of Education last September has aroused much interest. Under the London County Council there are now nearly 200 reading circles in connection with the N.H.R.U.; and reading circles in schools are also at work under the Gloucestershire, Middlesex, and Norfolk County Councils, and at Glasgow, Halifax, Leicester, Nottingham, Southport, and other towns.

BRITISH MUSEUM

BY MANY HANDS.

"Quot homines, tot sententiæ."

N.U.T. NOTES.

SUBJECTS of more urgent importance have hitherto prevented my devoting space to the class lists of the King's Scholarship Examinations, of which, by the way, there are *two*, this year. 10,369 of the candidates elected to take the complete examination in December last, and of these no less than 2590 failed outright. 8020 of the young teachers nearing the conclusion of their apprenticeship, on the other hand, chose to undergo their tests in two parts—a kind of qualifying examination in December, and a "Part II." in the following April. 2364 fell at the first fence, and 385 others failed altogether in "Part II." In the two examinations the total number of candidates who did not succeed in satisfying the very modest requirements of the examiners for a "pass" was 5339; which seems to point to the intellectual mediocrity of much of the material at present deemed adequate by an enlightened Board of Education for the instruction of thirty children, *in average attendance*. The lists of successful candidates contain columns headed, "Training College which Candidate wishes to enter"; and, at immense trouble and pains, I have, from the official lists themselves, ascertained the numbers of successful candidates who do, and who do *not*, signify their intention of completing their training. The results subjoined are illuminating, and further, most disquieting, to the thoughtful educationist:—

The Scholarship Lists.

I. COMPLETE EXAMINATION. December 1905.

(*A*) MEN.

Class.	Wish to Enter College.	Do not Intend to Enter College.	Total.
I.	191	44	235
II.	468	88	556
III.	496	145	641
(*B*) WOMEN.			
I.	551	399	950
II.	1215	909	2124
III.	1183	2090	3273

II. PART II. April 1906.

(*A*) MEN.

Class.	Wish to Enter College.	Do not Intend to Enter College.	Total.
I.	106	49	155
II.	223	88	311
III.	249	124	373
(*B*) WOMEN.			
I.	370	271	641
II.	689	804	1493
III.	547	1635	2182

A GLANCE at the above will, I imagine, convince all who love their profession of the wisdom of the Executive's decision to ask the Board of Education to abolish the Acting Teachers' Examination (say) five years hence. For the first time on record, actually a *majority* of those eligible have decided beforehand that, no matter what their position may be on the Scholarship list, they will not proceed to College; and of these 2652 are in the first and second classes! Two or three earnest, enthusiastic individuals have sent communications to the organ of the N.U.T. protesting that the abolition of the Acting Teachers' Examination will make the position of the present non-collegiate teachers intolerable. In my judgment, it is the one thing which will ultimately preserve their status as certificated teachers. In the past, the clearly expressed policy of the Union has been to demand equal treatment for all certificated teachers, mainly—if I understand aright—because the training college accommodation hitherto has been lamentably deficient, and, secondly, because what exists is chiefly at the disposal of those teachers ready to profess adhesion to a particular form of faith. The position is vastly different now that the alarmingly increasing indisposition of young teachers to proceed to college is so apparent, and unless something is done, and done speedily, no power on earth will be able to prevent differentiation in the rates of remuneration for college-trained teachers, and those trained in some other manner. My statement at the Executive that the standard of examination for acting teachers has been materially lowered during the past few years has been challenged in the *Schoolmaster*, but it was made on most excellent and reliable authority, viz. that of a gentleman who has prepared hundreds of acting teachers for their certificate examination. Probably his evidence would be fully corroborated by the talented and successful tutors who perform similar service in other parts of the country. "Adequate training for *every* teacher" must be our sole aim in the future."

Concerning the "Acting Teachers."

WHATEVER crises may occur in the history of the Union—and of these there is certainly no lack—we are not at all likely to run short of men willing and anxious to take the helm, however troublous the waters may be. Mr. Fred. C. Blackburn has definitely informed his own important association of West Ham that he will not be a candidate *this year*, his objects being first, to do nothing prejudicial to the chances of Mr. W. A. Nicholls, ex-President of the London Teachers' Association, by splitting the metropolitan vote, and, secondly, to evince his sincere sympathy with the class teachers, who, I may say at once, have always had in him a vigorous and stout-hearted friend. I am expressing what I know to be a general opinion when I say that I trust Mr. Blackburn will not by any means relinquish his hope of becoming President of the N.U.T. Behind his somewhat rugged exterior, he hides qualities of superlative merit; and for downright honesty and purpose, clearness of judgment, sterling grit, and unwavering fidelity to a cause

Still another "V.P." Candidate.

or a friend, he is not excelled by any of the Crichtons of Bolton House. Meanwhile another Richmond is in the field, and Mr. George T. Hyden, head-master of the Consett Iron Company's British School, has been duly nominated for the "Blue Ribbon" of the Union. Mr. Hyden is one of the representatives of the North of England electoral district, and has had the rather unique distinction of being unopposed four times out of the five in which he has sought election to the Executive. He won his spurs in both public and professional life long before his appearance at Russell Square, being a J.P. by virtue of his chairmanship of an Urban District Council, and having held all the offices in local teachers' organisations which were possible to him. He is now the chairman of the Union's Tenure Committee, in succession to Mr. T. P. Sykes, and, in this capacity, has rendered invaluable services to scores of distressed fellow-teachers. Whilst on this subject of the Vice-Presidency, may I reiterate the hope I uttered a month or two ago, that Mr. C. W. Hole, the popular and talented Hackney Treasurer for so many years, will ere long also enter the lists; for, in my humble opinion, his claims to the highest honours far transcend those of any of the candidates at present before the country.

❧ ❧ ❧

Conference Reform.

EVERY delegate must inevitably have returned from Scarborough with the conviction that although Conference is magnificent as a *demonstration*, as a deliberative assembly it leaves much to be desired; and, certainly, when one learns from official records that "over 2250 representatives from all parts of the country attended the Conference," one cannot deny the allegation that its decisions resemble legislation by "mass meeting." Rule 13 of the Union runs: "That each Association be permitted to send to Conference one representative for every ten members up to a maximum of ten representatives; but that each Association of less than ten members be permitted to send one representative"; but this rule, which may have been quite admirable at the Union's inception, is altogether unsuitable for an organisation whose membership will exceed 60,000 at the close of the year. It is as absurd as it is unfair that associations like Manchester (1510), Liverpool (1377), East Lambeth (1312), West Lambeth (1205), Finsbury (1141), Birmingham (1136), Hackney (1110), Sheffield (1095), Chelsea (1087), Leeds (1008), must remain content with the representation allotted to associations less than one-tenth their size and importance; and although I personally would in any alteration of rule have due regard for the difficulties of small associations, I would base representation on the number of members, allowing one delegate for every fifty, up to a maximum of twenty representatives, for the present. One effect of the Gargantuan size of Conference, to-day, is to limit its *locale* to health resorts and watering-places, for no industrial centre with moderate lodging accommodation can attempt to house the 2250 delegates and the hundreds of friends who come in their train. Possibly, at no distant date, we may adopt the proposal of the progressive Sheffield Association, and authorise the Executive to arrange sectional meetings during certain of the Conference sessions, on the lines of the British Association. This plan works admirably both in France and Belgium, and would probably be a success in this country, were it to secure a fair trial.

A. C.

NOTES FROM THE NORTH.

Superannuation.

THE Scottish Class Teachers' Association has issued an interesting booklet containing some suggestions for the amendment of the Superannuation Act of 1898. The writer is Mr. Alexander Small, one of the ex-Presidents of the Association. In his prefatory statement he says that the provisions of the Act, though originally conceived exclusively with reference to England and Wales, were at the last moment applied to Scotland, and yet no opportunity was given for the expression of Scottish opinion with regard to them. The opinions expressed and the suggestions made in the brochure refer almost entirely to Scotland. Teachers in Scotland, he asserts, base their claim for separate treatment not only on the injustice done them by the hasty inclusion of Scotland in the Bill of 1898, but on the fact that, in the matter of retiring allowances for teachers, the historical position of Scotland was quite different from that of England. It will probably be found that not a few of the amendments suggested by Mr. Small are applicable to both countries; but there is one essential difference, for he claims that Scottish teachers are strongly of opinion that the contribution to the Annuity Fund from the Local Authority should be secured to them by a short Bill dealing specially with the question.

❧ ❧ ❧

Points Discussed.

MR. SMALL discusses very briefly some of the points he would like to see embodied in any amended Act. He holds that service in Secondary Schools should be reckoned in calculating the amount of State allowance. In Scotland, where there is no bridge to gap between primary and secondary schools, this should not be difficult to secure. I have said there is no bridge. I ought perhaps to have qualified the phrase, as it is evident from the new Regulations with regard to the Training of Teachers that there is likely to be a barrier set up between the two classes of schools. It will be observed from the summary of the Regulations given last month that the teachers of higher subjects are to be outwith the scope of the Superannuation Act. This I hold to be a flaw in the new Regulations, but it may be due to the rules which govern the Act, rules which, as Mr. Small points out, should be amended. Again, he argues very cogently that the Local Authority should be allowed to contribute annually to the Annuity Fund a sum equal to the teachers' contribution. In this respect he is at variance with the recommendations of the N.U.T. But, as has been shown above, the conditions prevailing in Scotland prior to the passing of the Act were quite different in Scotland from those in England, and in so far as Scottish Local Authorities were in the habit of giving pensions to this extent, there would be no hardship in re-introducing this power. Whether this power should be compulsory or optional is a moot point, and one on which in Scotland there are different opinions held. To ask Local Authorities to contribute, and to permit them the option, seems to me a policy fraught with much danger. The fact that in a great many instances School Boards are paying the premium of teachers lends countenance to the view that they would be more than willing to contribute if they were given the power.

IN addition to giving School Boards the power to contribute, Mr. Small at the same time urges that the State allowance to existing and future teachers should be greatly increased, and at least doubled. These two conditions obtained, it would then be possible to secure the return of the teachers' contributions by placing the Annuity Fund on a money-returnable basis. At present this basis would be madness, as the resultant annuity would be so small that teachers would be forced to spend their years of retirement in the poorhouse. In conclusion, he advocates that special consideration should be given to the case of existing teachers. The improvements he suggests would make the retiring allowances to existing teachers equal to those for future teachers, and it seems hardly possible to secure this by way of amendment of the Act. Their case is special. When they became teachers there was no idea of compulsory retiral at a certain fixed age. In most cases their option of acceptance of the Act was quite nominal, and had, in fact, very little reality. Special treatment should, therefore, be accorded to them. From the moneys which accrue to Scotland as Grants in Aid, it should not be impossible to set aside a sufficient amount to meet all the necessities of the case, viz. that the retiring allowance of an existing teacher should at least be equal to that of a future teacher.

Money-Returnable Basis.

WHILE I do not seek to exaggerate the differences between the opinions of the Institute, as expressed in the booklet recently issued to Members of Parliament, and the opinions of the Class Teachers' Association, as shown in the pamphlet under discussion, yet it seems to even the most casual observer that there is disagreement somewhere. Mr. Small in his contentions more nearly approximates to the position held by the N.U.T., with this important difference, that he would seek to call in the Local Authority as a contributory. The Institute, on the other hand, desires no amendment of the present Act, and wishes it amended by being ended, and a new Act brought in to take its place. In the *meanwhile* policy of both there is of course agreement; they both desire to get hold of more money, either from the Grants in Aid or from the more recently acquired Equivalent Grants. But it seems as if neither was destined to see much credit for their labours, as in the recent discussion on the Scottish Estimates superannuation was given a very back place. Since then a petition signed by nearly three-fourths of the Scottish Members of Parliament has been presented to the Premier, asking that the superannuation of Scottish teachers should at once be taken up. Until there is a Scottish Grand Committee appointed, I see little prospect of Scottish educational legislation.

Differences.

IN connection with the grant to necessitous School Boards in England, it is interesting to note that Scotland is to share to some extent. All School Boards whose rate exceeds eighteenpence in the £ are to share in the grant. Three-fourths of the excess is to be met by the Government. It will to a large extent benefit some of the very highly rated parishes in the Highlands and rural districts of Scotland; but, on the other hand, it will not have any influence on the larger towns and cities. But the large School Boards of Scotland have been recently making an outcry against the increased expenditure demanded of them to cope with the ever-increasing demands of the Education Department. There can be little doubt that during the last decade the demands made by the Department have been very great, and in view of the abolition of pupil-teachers it is expected that there will be a greater rise in the near future. Of course such demands as the Department have made during that time have all been for the purpose of progress and development; nevertheless, where the school population has increased rapidly, it has been a matter of no little concern to School Boards to square accounts with the ratepayers and the Government without at the same time incurring considerable odium. The Education rate in Scotland is not a very popular one, and this unpopularity is very largely fanned by the Press.

Equivalent Grant.

THE Scottish Education Department have issued a very important circular dealing with a change of date in these examinations. At present the examinations are held at the end of June, and it is proposed that the written part of the examinations should take place immediately before the commencement of the short recess at Easter. By the change it is contemplated that there would be no difficulty in placing the results of the examinations in the hands of managers before the schools broke up for the summer vacation. Teachers and pupils would thus be freed from a serious anxiety which, under present conditions, must exercise an unfavourable influence upon the full enjoyment of their holiday. The disadvantage of the present time, viz. the existing arrangement in the case of schools whose holiday months are July and August, appears to me to be equally applicable to the recess at Easter. In very few parts of Scotland are the Spring holidays uniform. Glasgow and a few other places observe the Easter holiday; Edinburgh, Aberdeen, and Dundee have different dates. Since the Easter is a movable holiday, there seems to be as much difficulty in arranging for the Leaving Certificate Examination as at present. If the result of this change is to make Easter the time for all the holidays in Scotland, it would indeed be welcomed by the profession. But Corporations and Councils are not agreed on this. Some time ago the Institute tried to arrange that the holidays should all be taken at the same time, but this attempt met with failure. If, however, the Department can do better, we shall be glad to see the result. The Institute has long contemplated holding its Congress at Easter time, but the difficulty has been the difference of time in holidays.

Leaving Certificate Examinations.

THE new Regulations for the establishment of Provincial Committees for the Training of Teachers have hastened the resignation of Dr. Maurice Paterson, Rector of Moray House Training College, Edinburgh. Intimation has been given that he proposes to retire from the rectorship of the U.F. Training College in December next, and a movement has there-

Testimonial to Dr. M. Paterson, Moray House.

fore been initiated to afford all former Moray House students an opportunity of showing their high appreciation of his services in the cause of education, their admiration of his singleness of purpose and sincerity of character, and their esteem and regard for him as a friend. A committee has been appointed for the purpose, and subscriptions should be sent to Mrs. M. Kennedy, 9 Hartington Place, Edinburgh, or to Mr. Andrew W. Dick, M.A., Moray House, Edinburgh. In all likelihood there will be circulars sent out to all former Moray House students, but the committee are face to face with the difficulty that the names and addresses of many are unknown. The Secretary (Mr. Robert Dickson, Warrender Park School, Edinburgh) will be glad to have the names and addresses of any former students.

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E.I.S. Doings.

AS this is the holiday season in Scotland, very little is being done in official circles of the Institute. The September meeting, however, will soon be with us, and the changed place of meeting will no doubt attract a greater number of teachers to Edinburgh this year. The Edinburgh University have generously placed at the disposal of the Institute the M'Ewan Hall and the University Buildings. The M'Ewan Hall will be used for the meetings of delegates, while the publishers' exhibits will be housed in the University. The meetings of the Old Parochials will, however, take place in the Royal High School, as they require to give a year's notice of the change of place of meeting. R. G. D.

TRAINING COURSES IN OXFORD FOR "ONE-YEAR STUDENTS."

STUDENTS in Elementary Training Colleges are of three types: (1) those spending only one year in residence, who have hitherto been usually graduates, and have held a Government grant; (2) those passing two years in college, who are the most numerous class, and (3) those spending altogether three years over their course of study. The third-year student has been allowed in the past to go abroad, or to take the final course for a degree, but no opportunity has been afforded to the two-year students to get further training or qualifications. The changes made in the recent regulations tend to discourage University work and foreign study, and to encourage those students of the ordinary type who have done successful work in practical teaching since leaving college to take a further course of a more advanced type.

The important additions made to the Regulations on this subject are of so much interest that they are here quoted at length:—

"A third year of training has in the past been frequently granted to enable students to continue a specialised academic course of study for a University degree. Though a continuance of a teacher's general education is likely to increase his usefulness in his profession, it cannot be said that the academic courses which have been followed by many third-year students have been framed with any special regard for the needs of certificated teachers. While the Board do not desire to debar competent students from academic studies during the third year of training, they are anxious to encourage third-year courses of other types. In particular, a trained teacher who has been engaged in the active work of teaching for one or two years will often be in a position, by reason of his direct experience of teaching, to undertake with profit a renewed study of the Principles of Teaching. In such circumstances he may derive therefrom greater advantage than if he had taken the same course immediately after the end of his second year of training. The Board, therefore, propose a third year of training to selected trained teachers who have served in Public Elementary Schools for not more than four years after leaving a Training College."

It is to be hoped that many trained teachers who are now in active work will take advantage of this generous offer of the Board and enter upon the proposed third year's course.

There is, perhaps, no more desirable place than Oxford in which to spend this extra year of training. It may not generally be known that Cherwell Hall has recently been recognised as a college for one-year students of this type, and courses of study such as the following have been arranged for them:—

(1) Special work in Psychology, Logic, Ethics, History, and Theory of Education, both in the University and with the lecturers at Cherwell Hall.

(2) A special course for teachers of little children, including preparation for the examinations of the National Froebel Union.

(3) Geography, for which the University offers peculiar advantages at the School of Geography.

Students at Cherwell Hall are always taken through a thorough course of the principles of Herbart and Froebel. The Practising School, Milham Ford, and the extensive College grounds offer ample opportunity for complete courses of Nature Study, including the management of the school gardens; while handicrafts of various kind are taught to all who wish it.

Large extensions are being made to the Hall, including lecture-rooms, common rooms, and study bedrooms for thirty more students; the life is arranged as in other Women's Colleges, and every opportunity given for healthy exercise and recreation; tennis, boating, and cycling are thoroughly appreciated by all, as well as the beautiful garden with the river Cherwell running past the foot.

Owing to the grant generously made by the Government, it is possible to receive third-year students at £10 a term, and attention is called to the fact that, besides this grant, those who desire it may draw upon the College Loan Fund.

All teachers wishing for full particulars should write at once to the Principal, who will be glad to answer any inquiries; but it is pointed out that applications for the grant should be made *immediately*, as the Government have fixed an early date for receiving such.

Rural Evening Schools.—The Board of Education has issued a Memorandum full of valuable suggestions respecting courses of work in rural evening schools. It is suggested that education authorities should provide instruction designed to enable the student to supplement his ordinary earnings by work in the cottage garden, allotment, and small holding.

THE BRITISH ASSOCIATION AT YORK.

(BY OUR SPECIAL CORRESPONDENT.)

THE genuine student of education expects a great deal from Section L of the British Association. Here is a meeting-ground for educationists with more or less of a single aim. To the scientific thinker on this subject there is neither Churchman nor Nonconformist, Catholic nor Protestant. The adequate preparation of the child for full and complete citizenship is the end and aim of all his efforts. He endeavours to see education whole, and to close his eyes—brave man—to the social considerations which hamper all our best efforts towards efficient organisation. If he is regarded with amused contempt by the "practical man," he can afford to wait.

This truly catholic educational congress meets, however, at an unfortunate period—the country sweltering under a summer sun; educationists who combine practice with theory tired of themselves and their work, longing for the sea and the moor, where problems cease from troubling; the general public sick to the heart of "education," fondly thinking that it has been the subject of debate in the Commons for the last few weeks. The scientist is nothing, however, if he is not brave.

A glance at the programme for the meeting at York was encouraging—a presidential address by Professor Sadler, followed by discussions touching upon real, live questions of practical and pressing importance, viz., the balance of subjects in the curriculum of the primary and secondary school respectively, the adequate preparation of the teacher for his work, and the testing of that work by examination or otherwise. If any fault was to be found with these arrangements, it was that the programme was too comprehensive for three morning discussions, assuming that the British Association aims at reaching the ear of the general public. It is, indeed, the fault of nearly all educational conferences. The British public can deal with only one idea at a time, concentrated in a phrase—alliterative if possible. Whether, by the way, this worship of alliteration is the result of too diligent reading of the *Daily Mail*, or of the poems of Mr. Swinburne, is an anthropological problem which we commend to Mr. Andrew Lang or to a future meeting of Section H of the British Association.

Professor Sadler in his presidential address frankly confessed his inability to supply us with a complete chart of the educational voyage into the unknown. In his opinion, however, we have begun to move, and are no longer stranded in the mud. "We have moved, often unconsciously, from our old moorings. A strong current which we could not resist has shifted us from where we lay, more or less comfortably, before. And we have had to move in a fog, a puzzling and dangerous fog, now impenetrably thick, and now lifting enough to show that we are still moving fast into unfamiliar waters. First on one side, and then on another, we have heard angry cries of impending collision; but the current carries us on amid conflicting advice as to the handling of the boat, and much discord of opinion as to whither we are really going."

Then followed an attempt to chart at least the first stage of the voyage. In administrative affairs "the cantonal principle and the national principle are struggling for the mastery." The central authority promises to obtain control, because the tendency is to centralise expenditure. Some attempt has been made to unify the management of educational affairs to the advantage of all grades. The State is becoming a universal foster-mother—some would say grandmother—and undertaking, for good or evil, those duties which some of us used to regard as parental. Education is not a sectional affair, but concerns the citizen in his communal capacity. "At point after point purely educational questions are implicated with economic and social problems, and we are forced to the conclusion that educational reform involves the intrepid handling of evils which lie outside the class-room, and affect the home life and economic welfare of parents and children alike." Then came an attempt to focus discussion, and we might do worse than follow Professor Sadler's lead in drafting programmes for educational conferences during the coming year. The three pressing needs of English education are, in his opinion, scientifically planned experiments (1) in the use of new methods of teaching; (2) in new grouping of studies; (3) in the closer adaptation of different forms of school training to the practical needs of later life.

With regard to the papers read and discussed at the three subsequent meetings, may we ask indulgence for concentrating attention upon the burning question of curriculum, the second of the three points emphasised by the President? If there is one matter upon which all thoughtful educationists are agreed it is this—that the curriculum both in the primary and secondary school is absurdly overcrowded. Too much is attempted, with the natural result that too little is done. At the present time, on a moderate estimate, one-half of the intellectual effort of the ordinary school is absolutely wasted. This is the natural accompaniment of a period of change. The scientific thinker has so far made his influence felt that education is no longer synonymous with instruction. The word now connotes something wider, fuller, more complete. It covers not only instruction but training, and training not merely of the mental faculties, but also of the physical and moral side of child nature. This is generally recognised in theory, and repeatedly quoted as a platitude, but the recognition has not as yet been accompanied by any definite simplification or concentration of the conventional curriculum, which aims at storing the youthful mind to repletion, at teaching to know rather than teaching to be. How to cut away the unnecessary, how to combine, correlate, or fuse the orthodox branches of the ordinary school curriculum, how to concentrate intellectual effort in order to leave time for attention to the physical and moral needs of the pupil, is by far the most important practical problem confronting the educational world at the present time.

It will do us no harm to face the fact that the teacher, according to the new educational socialism, is not only to fit the child for making a living, but also to stand *in loco parentis* as well as *in loco pastoris*. If this is to be his comprehensive work, the purely intellectual and informative part of it must be reduced in a very material manner. He must not be expected to turn out lightning calculators or animated ready reckoners. He must not be held up to public ridicule if his pupils cannot tell off hand what is 5 per cent. of £6, 9s. 2d. (an actual conundrum set to a palpitating candidate for the post of office boy), or to calculate by

"the good old rule of practice" the value of 5923¾ articles at £2, 18s. 9¾d. each. It is not humanly possible for him to endow the average pupil with "a taste for the best literature," or to do more than introduce him to history and geography, properly so called. Those whose business it is to impose the curriculum upon the schools, must not add one "subject" after another to the portentous list at the instigation of outside specialists or irresponsible cranks.

Let us thankfully acknowledge that there is a strong and widespread desire, born of confusion, overpressure, and waste of effort, to "simplify the curriculum" of the primary school at least. But, up to the present, most of those who have tackled the thorny problem have merely counted the "subjects" as well as the number of school hours in the week and then stood petrified with their hands in the air. The next step will probably be the dropping of certain branches which are thought to be "useless" in a mechanical manner, though there are signs of an endeavour to combine or correlate one division of school work with another. There is also a decided movement in favour of reducing the dimensions and scope of several of the traditional subjects, as, *e.g.*, in arithmetic, much of which is neither educationally nor practically useful, and in English grammar, of which the only really necessary portion is that which directly bears upon oral or written composition. But something more drastic and revolutionary is required. The whole primary curriculum must be scrapped. We require in this State Department a First Lord with Napoleonic qualities of administration and courage unlimited.

PROFESSOR MICHAEL SADLER.
(From a Photo by the Dover Street Studios, 38 Dover Street, Mayfair, London.)

The primary curriculum is in a sufficiently congested state, but it is simplicity itself compared with that of the ordinary secondary day schools. Here the examination of the old style still reigns supreme, for the only educational result that a middle-class British parent can appreciate is a certificate and a long list of "honours" at the end of a prospectus. Consequently the curriculum is on the whole wooden, artificial, and foolishly ambitious to the last degree. On the other hand, we have in the great boarding schools of the best type some unity of aim and purpose. Here the teacher is actually *in loco parentis* as well as *in loco pastoris*, and faulty though the system may be in many ways, it is yet the soundest, scientifically speaking, that is to be found the world over. Reform the intellectual curriculum of these schools so that it develops powers of independent thought and initiative, and you will come as near to the ideal as is possible in this imperfect world. Whether it is right that the parent should delegate his functions to a substitute is a moot point, but it will be readily acknowledged that it is often to the immense advantage of his offspring that he does so. Here is food for thought, but we must not digress.

On this pressing matter of reorganisation and simplification of the curriculum, then, had the British Association anything helpful to say?

Sir Philip Magnus presented a printed report on the *Studies most suitable for Elementary Schools*, the fruits of the deliberations of an influential committee appointed by the Association in 1903. The first portion of this document reminds us forcibly of the transcendental *Suggestions* published by the Board of Education last year. The greater part of the remainder deals with the teaching of Arithmetic and Mensuration, Nature Study and Housewifery, and is also, to a great extent, on the lines already laid down by Whitehall. We find here no constructive effort at framing a simple yet comprehensive primary curriculum. Much of the report consists of counsels of perfection of the kind to which practical educational workers are now inured. But it is important enough to merit careful consideration, and in a future issue of *The Practical Teacher* we hope to return to it.

Several times during the course of his address the President made reference to this most important matter of curriculum. "They had been very wasteful," he said, "of the more ordinary kinds of intellectual material, they had done pitifully little to teach the mother tongue, *they had far too little in their school lessons to kindle the imagination, which on social, political, economic, and on other grounds they greatly and urgently needed*, and

by their worship of examinations they too often encouraged, on the part of both teachers and learners, a wrong attitude of mind." We have ventured to emphasise above a sentence which appears to us to be one of the most true, striking, and, in a sense, original utterances on educational matters of the last decade. Here is at least one guiding principle in the matter of curriculum. If we had space we could prove that the lack of imagination has, for example, a great deal to do with the unemployed question. If Professor Sadler would develop this idea for educationists and teachers generally, he would confer one more great and lasting benefit upon his generation.

Professor Sadler spoke later of "the remodelling of the curriculum of some elementary schools, so as to give a much larger place to handwork and practical training." We may be captious, but the use of the word "some" in this connection appears to us to be unfortunate. It suggests the special training of a certain section of the children of our schools as hewers of wood and drawers of water, or at least as artisans—though some of them may be born artists! In the place of "some elementary schools," may we suggest "the primary grades" generally, irrespective of class or environment. All pupils of a certain age ought to be definitely trained to use hand and eye as an integral part of the complete process of education, and with the direct object of making them better fitted to profit by intellectual training. For they will thus, as careful experiment on a small scale has conclusively proved, cover the ground more quickly because of the increased intelligence which follows upon the acquirement of a steady balance between the physical and the intellectual.

The curriculum of the primary school as sketched by Mr. Burrell, the Principal of Borough Road Training College, was sufficiently removed from the orthodox "three R's" to satisfy the most original educational thinker. The following is the suggested grouping of the subjects:—

1. *Physical Work.*—The following come under consideration: Dress, ventilation of rooms, games, central playing grounds, and all that belongs to the understanding, care, and training of the body.

2. *Tool Work.*—Tools are means of shortening and perfecting labour. The pen, the pencil, the ruler, the brush, the scale, compasses, carpenters' and joiners' tools, the needle (for boys), and such tools as may be required for boys of special aptitudes are to be instruments of skill and alertness.

3. *Geographical Work.* — As history is based on geography, the two are considered together. (*a*) The map and the lantern. (*b*) The main features of physical geography, the inventions and processes in use, and the most pressing questions and problems. (This is to take the place of the chemical or physical laboratory in early days of school.) (*c*) The frequent reading of guide-books, books of travel and exploration, and books on the flora and fauna of great divisions of the globe. (*d*) History taught on the concentric system.

4. *English Work*, including reading, spelling, composition, and literature.

5. *Elementary Mathematics*, chiefly mental.

6. *Singing, Speaking, and Voice Production.*

Here is a ready-made syllabus for an educational meeting during the coming winter, the purpose of the debate being to decide how far this outline of a primary curriculum satisfies the educational and social needs of the present day. In our own opinion it is up to date, as we have already said, in its departure from the orthodox, in its insistence on physical training, and the organisation of that bodily activity which comes natural to every healthy boy and girl. For ourselves we should attempt a rearrangement of sections 3 and 4 on other lines. We need a new subject, which for want of a better term we shall name Humanity. It includes geography, history, and literature in close connection, and its purpose is to interest the pupil—no difficult task—in the surroundings, life, and thought of the various peoples of the world. We should specially commend the breaking away from the narrowing term Arithmetic, and the adoption of the wider term Elementary Mathematics, upon which one might further improve by the use of the simpler and more expressive phrase, Number Work. And so on *ad lib.* In such a discussion there would be, of necessity, much useless talk, much intellectual groping, but this is inevitable. Even the British Association was not free from it.

We like the practical note of the contribution of Professor Millicent Mackenzie on the problem of *Girls' Education in Elementary Schools.* Here we go to the root of the matter. Here is a refreshingly direct onslaught on the old ideas of the function of the school. "Reading aloud, writing, and arithmetic have little value as regards character training, and are too often meaningless acts to girls in the poorer parts of our great cities where people do not read or write, and have no money to invest. Even sewing and cookery as taught (although no doubt of value to those who can practise at home) are quite out of relation to life as they know it. . . . The *curriculum must be simplified* as regards number of subjects, and only those retained which bear directly on life and character. . . . Arithmetic, reading, and writing are to be subordinate to the study of practical matters and of history, literature, and geography." In other words, the State must be the nursing mother, and the time that is left over from teaching the offspring to live must be employed in intellectual study of a humanising character. For thirty years all our primary education has been purely and severely technical—we have trained clerks!

After striking a most necessary note of warning against the overdoing of athletic exercises, Sir Lauder Brunton insisted upon the necessity of the school concerning itself with the encouragement of bodily activity as a necessary forerunner and accompaniment of pleasurable and profitable mental alertness. We give his "practical" suggestions as he offered them himself. "The old war games, such as 'I spy' and 'Prisoner's Base,' might be adapted to modern warfare, or J. Fenimore Cooper's novels might be used to teach scouting to the bands of white men or Indians into which the boys might divide themselves. Some people may argue that such a course would tend to foster a spirit of militarism in this country. For my own part I believe that it would be just the reverse; that such training would greatly help boys to become volunteers, and that with an almost universal system of volunteering we might lessen our army without risk, *keeping a corresponding amount of tax money in our pockets*, and live free from the dread of foreign invasion on the one hand, or from universal conscription on the other." The

words here printed in italics ought to make John Bull interested in education, even in the dog days. But Sir Lauder Brunton is too optimistic surely! If, by the way, the aforesaid John Bull regards conscription as a red rag, we would beg to remind him that a knowledge of military scouting will make a boy able to scout well for his living.

Turning now to the question of the secondary curriculum, we must note at the outset that the headmaster of Eton is of opinion that it matters little or nothing what we teach, so long as we get the training value out of the subject in hand. But Mr. A. C. Benson takes a more modern view of the subject under discussion. "For the large majority of average boys," he says, "the classical system, however conscientiously administered, is, under present conditions, a deliberate disregarding of most of the methods by which intellectual influences may be brought to bear on the young." This is straight and from the shoulder. Then a little later we have due emphasis laid on what we must insist upon calling *the* educational problem.

"The crying need is *simplification*. By taking out of the ordinary educational scheme, one by one, all the component parts which are not absolutely essential, and by keeping the balance of subjects carefully in view, it would be possible to arrive at a simple core of education which should be available for all boys, while a little should be added at one point or another, with careful reference to the tasks and abilities of individual boys, by which the emphasis might be laid on one group of subjects rather than on another."

Mr. Benson's "core of education" is as follows:—

(1) French; (2) Arithmetic; (3) Modern History, English and European; (4) Geography; (5) Elementary Science; (6) Bible Teaching, and (7) English, which should form the central core of education.

This is, of course, almost purely intellectual. The schools which Mr. Benson has in view have always placed the physical training well in the foreground. The problem here is different from that in the sphere of primary education. There is no attempt on Mr. Benson's part either at "scientific grouping," as the modern educationist understands the term, but the subjects enumerated are selected for their practical value in the early intellectual training of an English gentleman. But Mr. Benson's education "core" is suggestive as well as modern in the best sense of the ill-used term. It embodies not only his own ideas but those of the most enlightened and practical reformers in that branch of educational work which is misnamed "secondary."

Given the "core," Mr. Benson would add to it at a later date according to a boy's "special idiosyncrasies." A boy "with literary and linguistic tastes might do Latin, Greek, and possibly German; a boy who is linguistic and not literary could do German and be spared Greek; and so on similarly with each subject, so that every boy would have a solid centre of necessary work, and as large a margin as possible of work that specially interests him." So with a counterblast to the old ideas of school curriculum Mr. Benson concludes his valuable contribution to the controversy. It forms a good summing-up of the situation. "Experience is against the theory that boys are taught accuracy by compelling them to devote their time and energy to work that is irredeemably and essentially dull."

Professor A. Smithells dealt with *School Training for Home Duties of Women*, with reference to the requirements of "girls who are better off and are in secondary schools." The idea that such girls generally get all that is necessary of this training within their own homes was swept aside abruptly and courageously by the Professor. "The homes in question," he said, "are often very much worse managed, and the seat of much more ignorance, prejudice, and folly, than their presiding geniuses have any idea of." This is direct enough, and on the whole true enough. The leading idea of the Professor's subsequent remarks was to frame the scientific portion of the school curriculum so that it might have a practically useful bearing upon the management of a middle-class home. The science of the school "lab" is too formal and academic, and has no bearing upon "the oven that won't heat, the jelly that won't set, the meat that won't keep, the fire that won't draw." Schoolmistresses "with high degrees in science can give no intelligible account of the hot-water system in any ordinary house, and have no opinion as to whether a hand-mirror is a satisfactory test for a damp bed. . . . They know nothing of gas-meters, filters, or clinical thermometers, and are paralysed before a smoky chimney." Which is all too sadly true. We shall ourselves write to the Professor about that hand-mirror before our autumn holiday begins.

Miss C. M. Mason is a Section in herself. She represents *Books* in education in an age when these instruments are too much discredited. "The methods and curriculum are too bookish" cry the reformers, one and all. "The intellectual education to be derived from *Books* is still to seek," says Miss Mason. "Every scholar should study with delight his own living *books* on each subject. Knowledge concerning persons and peoples can best be derived from *books*. The children must enjoy the *book*. The reading of it must cause that intellectual stir which marks the inception of ideas." Publishers of school-books need not, however, quote Miss Mason. It is not the *biblia abiblia* that are meant, but real books, books written without any specific reference to the school at all.

Thus we have plenty of ideas, but no definite policy, an almost frenzied insistence upon the presence of the disease with little help as to the remedy; but we have at least the assurance of Professor Sadler that we are beginning to move, which is something.

German Recruits.—We often hear comparisons between English and German schools which are altogether in favour of the latter, and the accounts of the excellent schools of which we read lead us to think that they are types of the general primary school in Germany. From a report issued by the Prussian Minister of War, there still seems to be a vast amount of crass ignorance among army recruits. Thus a childishly simple sum was wrong in 85 cases out of 100, and 106 out of 200 could not say what was the opposite of "courage." It seems that in Silesia it is no uncommon thing for 120 to 150 children to be in charge of one teacher, and in Breslau there are 132 schools in which 90 children fall to the care of one teacher.

IS RADIUM A COMPOUND?

BY S. IRWIN CROOKES, A.M.I.E.E., F.C.S.

RADIUM is so entirely different from all other elements that one is inclined to think that it must be a compound. First of all, Radium emits an α-particle, positively charged, whose mass is twice that of a Hydrogen atom. The residue again disintegrates, and in doing so, gives off another α-particle. This process is repeated several times, and continues until five or six α-particles have been emitted. It has been suggested that the ultimate residue, or final product of disintegration, is Polonium.

To return to the α-particles, it seems very probable that when their charge is neutralised by a negative corpuscle they become Helium atoms. *Assuming* the truth of the above, and that Radium is a compound, it has been suggested that the formula for such a compound radical would be $PoHe_5$ or $PoHe_6$; or if the final product is some other unknown element, say U, the formula would be UHe_5 or UHe_6. In passing it is worth noting that the above suggested formula takes no account whatever of the β-particles.

Probably the idea that Radium is a compound has arisen from the fact that in the past, all elements discovered prior to the radio-active period have always been obtained from compounds. Ramsay and Soddy have proved beyond a doubt that Helium can be obtained from Radium. Perhaps it would be more exact to say that Radium produces Helium. The identity of this substance obtained from Radium was established by means of its spectrum. Ramsay's method of procedure was somewhat as follows. By the aid of liquid air and a special manometric arrangement, some Radium emanation was forced into a spectrum tube and there retained for some time. The gas thus collected was examined by means of the spectroscope. The first examination gave an unknown but characteristic spectrum, which was thought by Ramsay and Soddy to be the spectrum of the Radium emanation. Three days later the well-known D line appeared in the spectrum, and after another two days the whole of the seven lines due to Helium appeared. The same spectrum is given by Helium obtained from Radium, by Helium from Cleveite, and by the Helium in the sun. It is worth mentioning that *Helios* is Greek for sun, as its existence in the sun was known some time before it had been discovered on the earth. It was a *fitting coincidence* that Ramsay should discover that Radium produced Helium, as he was the discoverer of Helium in the mineral Cleveite. This production of another element—Helium—from Radium is probably the strongest argument which can be adduced in favour of the compound nature of Radium. Should this view be correct, the chemist will have to revise many of the fundamentals of his science. Most of the other elements would have to be regarded as compound radicals, the only probable exceptions being Helium, and a few other elements of low atomic weight; a new definition would have to be adopted for "element," and the whole science of chemistry revolutionised. Another point which is taken by some to indicate the compound nature of Radium is that the *velocity* of radio-active processes is independent of temperature. In support of this it is argued that there are cases on record of certain *molecular* processes taking place with a velocity which is independent of the temperature within certain limits—*e.g.*, certain cases of super-cooling. Advocates of this view say that, though these radio-active processes involve enormous amounts of energy, there is no direct reason why such processes should take place at a rate independent of temperature, even though they may not be purely atomic in character.

The above forms a brief *résumé* of the chief points supporting the hypothesis that Radium is a compound. The evidence *against* this hypothesis must now be considered.

If Radium is a chemical compound, the changes taking place must be looked at from the point of view of ordinary chemical reactions. What is the result when this point of view is taken? We find that in this case we have, to put it mildly, a most flagrant exception, a case in which *one million times as much energy* is set free as is liberated during the most violent chemical reaction known—a most unlikely contingency. The production of Helium being unaffected by exceedingly wide ranges of temperature, also militates against the non-elemental view, as there is *not* another chemical reaction which is unaffected during such an enormous temperature range—from ordinary temperatures to that of liquid air. The spectrum of Radium is definite, its atomic weight (225) is fairly definite, its chemical behaviour is definite, and its relationship to the group Calcium, Barium, and Strontium, seems definite. All these facts point to the elemental nature of Radium, which also comes under our present definition of an element. The breaking-up which does occur in connection with Radium occurs spontaneously, and is neither accelerated nor retarded by chemical or physical agencies. The *chemical atom* is defined as "the smallest chemical unit which enters into combination with other substances, and which cannot be broken up by the action of the physical and chemical forces at our disposal." Up to the present Radium comes under this definition. The enormous amounts of energy involved, and the peculiarity of the changes occurring in connection with Radium, make it more reasonable and natural to suppose, that these changes are probably due to the smashing of the atom rather than the molecule. The activity and heating effect of Radium, the rate of decay of the emanation, are all unaffected by the most drastic physical and chemical treatment. The past experience of chemists in attempting to break up atoms would lead us to expect these last-mentioned results, if the changes are due to internal actions within the radio-element itself. Rutherford and Soddy's disintegration theory also favours the elemental view of Radium. The substances produced during the disintegration are of the nature of chemical elements, and differ only from the ordinary elements in being temporary. The entire process of disintegration as given by Rutherford is:—

Radium → Emanation → Radium A → Radium B → Radium C → Radium D → Radium E → Radium F.

The latter is thought to be identical with Polonium and Radio-tellurium. These transitory forms are termed "metabolons" by Professors Rutherford and Soddy. During its existence the metabolon behaves like an ordinary chemical atom. As stated by Professor Soddy in "The Wilde Lecture" he gave at Manchester, no indication is given by the metabolon of its approaching end, "but suddenly, by some internal cataclysm, the cause of which is at present almost beyond conjecture,

it flies to pieces, and ceases to exist in the form previously assumed. A new world is thus opened out, in which the atom is not the unit, in which the forces are not chemical, and in which physical conceptions such as temperature are without meaning." This quotation alone, from the remarks of one of the great workers on Radio-activity, is sufficient to indicate that Radium cannot very easily be brought within the category of ordinary chemical compounds.

Enough has been said to show that Radium may reasonably be looked upon as the progenitor of Helium. In much the same way *Uranium* is said to be the *parent* of *Radium*. Boltwood, in the *Philosophical Magazine*, advances this view, and supports it by the following facts. He analysed twenty-two different samples of Radium ores, twelve of which were distinct minerals, and in every case he found that the quantity of Radium present in each sample was *directly proportional* to the quantity of Uranium present. Here we have another case of the transmutation of the elements—the dream of the old alchemists become a reality. Whilst this is so, our knowledge is yet too scanty to enable us to control these transformations. The secret is still in the future, and with it many possibilities, not the least being a means of controlling the enormous amounts of energy—with consequent applications—involved in these intra-atomic changes.

A VISIT TO A BELGIAN CONVENT SCHOOL.

THE problem of "What to do with our Boys" is hardly more difficult to solve than "What to do with our Girls," especially when they have reached the age of fourteen or fifteen, and there is no school within easy access which will afford the necessary training and teaching. It was a problem over which Janet and I had many serious debates before we could report progress.

The schools in England of which we knew fell into two classes, those where the teaching was of a second-rate order, and not in the least useful for a girl who would

NEDERBRAKEL: PENSIONNAT DES SŒURS DU SAINT-CŒUR DE MARIE.

General View.

have to do something to earn a part of her expenses, and those where the teaching and training were what we desired, but where the fees were prohibitive and the "extras" appalling. A suggestion from a friend led to our trying Belgian schools, and finally selecting a convent school, not without some objection from Janet, who did not like the prospect of her girl being so far away, for a year at least, and with some doubt on both our parts as to whether it would be advisable for a child, with parents old-fashioned enough to be Church of England people, to enter a Roman Catholic school. The first objection was waived in consideration of the

Blessing the Grotto.

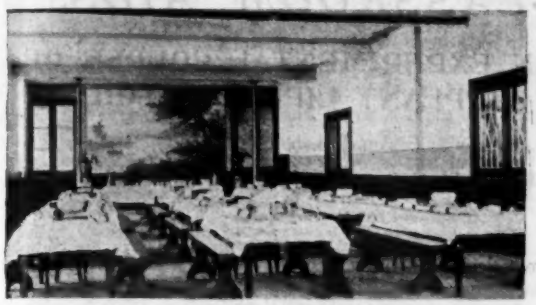
advantages to character and self-reliance, which were bound to accrue from such a cutting of the apron-strings, and the second was overcome by the guarantee of the Father Director that no attempts were made in any way to influence a child's belief, and that religious discussions were absolutely forbidden in the school.

Satisfied on these points, we determined to take Eileen across the Channel. A singularly smooth crossing from Dover to Ostend, a short run in the excellent train of the Belgian State Railway, landed us in Ghent. There we changed, and, leaving the main line to Brussels, ran south through undulating country to our destination, Nederbrakel, which we reached in the evening. All the English girls in the convent were at the little station waiting to welcome the new-comer, and a five minutes' walk through the school grounds, amid some little excitement, brought us to the convent. The good sisters had provided a supper, which was more than acceptable, and, as closing time was drawing near and we were somewhat tired, Janet was glad to be shown to her room in the convent, while I went off to the Pomme d'Or, a clean little estaminet in the main street of the town. Nederbrakel is a town of some five or six thousand of a population, the chief industries being glove-making, match-making, and of course agriculture.

After breakfast, we made a tour of the school and grounds under the guidance of one of the sisters, who was most anxious to satisfy all our doubts by letting us judge for ourselves. The convent and its buildings stand in about twenty acres of ground, and comprise the boarding school, with about a hundred and forty pupils, of ages varying from two to nineteen years, the convent, of fifty to sixty sisters, the pensionnat where paying guests are received, the chapel, the house and grounds of the Father Director, and the day school or externat. The school, in which we were mainly interested, is well-built and roomy, with excellent sanitation (not always found on the Continent, as many readers well know), and equipped as well as a good secondary school in England. In addition to the necessary class rooms there are half-a-dozen music rooms, a dress-making room, large play rooms, a large covered verandah for wet or inclement weather; the *réfectoire* is spacious and airy, and the *dortoir* (or dormitory) is divided into cubicles, which are screened from the

passage by heavy white curtains. The whole building is spotlessly clean. The exterior walls towards the garden are covered with rose-trees, and fruit trees of various kinds. The grounds are prettily laid out, with creeper covered arches where study is done in hot weather, ponds, shaded walks, a grotto, and open fields. Enough vegetables are grown to supply the convent, and a small herd of cows provides milk, cream, and butter.

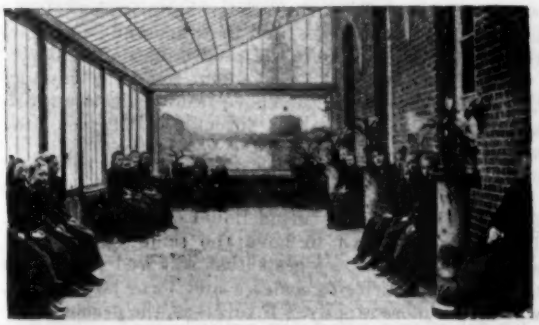
The ordinary course of instruction comprises English, French, German, Reading, Arithmetic, Bookkeeping,



The Dining Hall.

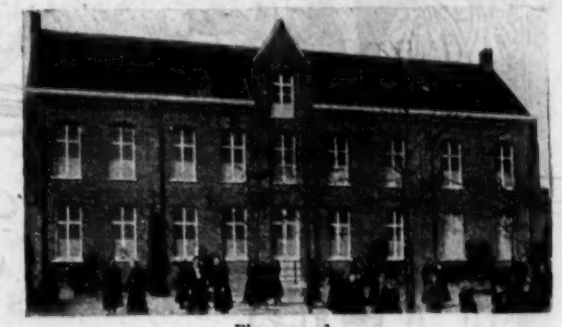
History, Geography, Domestic Economy, Plain and Fancy Needlework, and Gymnastics, Music (Singing, Piano), Drawing, Painting. Dressmaking, Shorthand, Typewriting are extras.

The methods of teaching are good, although in a short visit it was impossible to examine them carefully, but we can judge from the specimens of work we saw and the progress already made by Eileen. We wished her particularly to learn French. So she is debarred from speaking English from Monday morning to Saturday night. In addition to the ordinary lessons, she must learn and repeat five sentences in French daily, with the result that after a few weeks' residence she could write a letter home in French, which, though by no means faultless, was better than she would have done in as many months in England.



The Verandah.

The daily routine runs somewhat as follows:—The girls get up at 5 A.M., and after a service in the chapel have early breakfast at 6.30. This consists of "tartines" and coffee. (For those unacquainted with Continental breakfasts, I may explain that "tartines" are bread and butter sandwiches—home-made bread and beautiful butter.) From 7 till 9 the girls are at study. At 9 there is a second breakfast, from half-past 9 to 11 more lessons, and at 11.30 dinner, consisting of soup and two courses of meat and vegetables.



Playground.

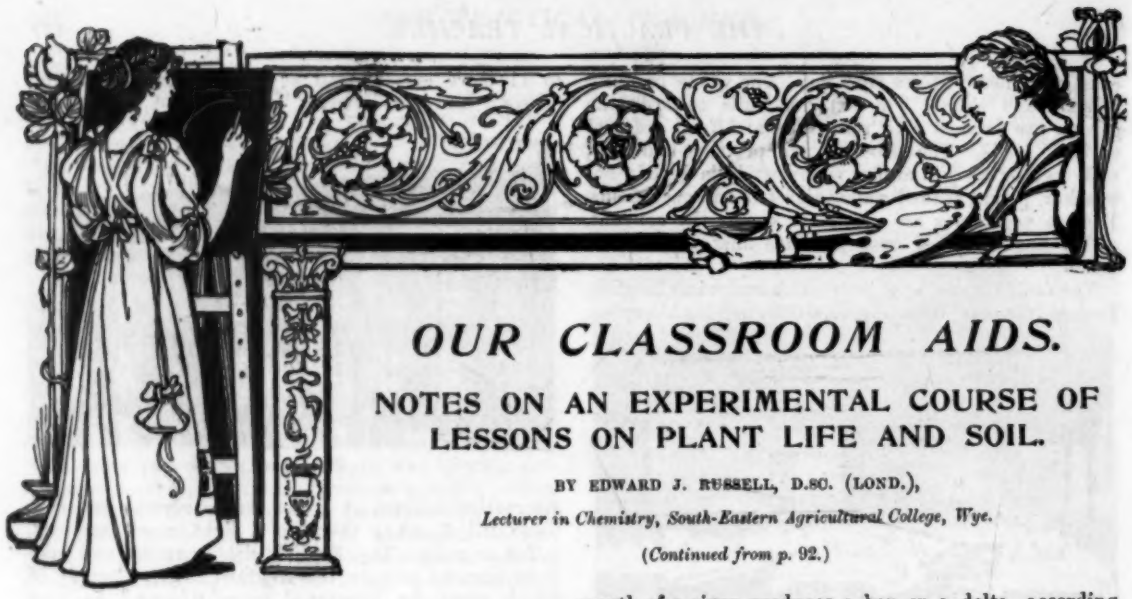
Recreation follows, at 1 the classes resume and continue till 4, when there is a light meal—tartines, coffee or milk. The English girls have tea and take it in turn to provide the fragrant herb, a supply of which must be forwarded from "home," as that obtained on the Continent is a very poor variety. From 5 till 6.30 lessons are being prepared for the morrow, and, after a short service in the chapel, hot supper is served at 7—soup, meat, and vegetables. By 8 o'clock the pupils are in bed, and, as Eileen has

The Dormitory.

remarked, "Very glad to get there." The monotony of the routine is, of course, broken by walks, picnics, excursions, when the weather permits.

We had unlimited opportunities of talking confidentially with the English girls, some of whom had been there for four or five years, and they were enthusiastic in the praises of the school, and we have already had a request from Eileen that she may stay another year beyond the period arranged for.

The most pleasing feature of the school is the admirable tone. The discipline is firm but kind.



OUR CLASSROOM AIDS.

NOTES ON AN EXPERIMENTAL COURSE OF LESSONS ON PLANT LIFE AND SOIL.

BY EDWARD J. RUSSELL, D.SC. (LOND.),

Lecturer in Chemistry, South-Eastern Agricultural College, Wye.

(*Continued from p. 92.*)

The Action of Running Water on Soil.

Experiment 70 may be somewhat modified to illustrate more clearly what happens during the flow of a river.

Experiment 71.—Put some soil into a small beaker, fixed so that its lip is just above the edge of a much larger one. Arrange for a supply of water to run through the small beaker, either from an aspirator bottle or from a Winchester quart bottle with syphon attachment. It is an advantage to smear the outside of the beaker, just round the lip, with vaseline; the water then runs out in a more uniform stream, instead of spreading itself over the glass.

Note that a turbid stream of water issues from the small beaker, leaving behind only coarse sand and gravel; in a short time this beaker contains clean water. The large beaker contains turbid water, and also gives a muddy sediment; the water issuing from it is turbid and should be collected in two lots.

To one of these lots add about 25 per cent. of its volume of sea water, or about 5 per cent. of its volume of a saturated solution of common salt. In a short time the suspended matter has deposited, leaving a clear solution, while the other lot of water still remains turbid. Salt evidently facilitates the deposition.

The water in the small beaker may be likened to a mountain stream; the rapid current washes away all fine particles and leaves only coarse gravel, sand, etc. The water is clear and the bed sandy or stony. The large beaker shows what happens in the river; the volume of water is larger, but the velocity of the current is usually less, and fine matter deposits, forming a muddy bed. There is, however, a distinct flow, and the finest particles have not time to settle, but are carried onwards.

When the turbid water comes into the sea most of the suspended matter is deposited. Two causes combine to bring about this result: the salts dissolved in the sea water exert a peculiar action, not yet understood, but easily shown in this experiment, and there is also a decrease in the rate of flow when the river widens out into the estuary. This deposit at the mouth of a river produces a bar or a delta, according to circumstances.

Permeability of Soil to Water.

Experiment 72.—Cut two discs of perforated zinc, about one inch in diameter; place one in each of two funnels and cover with filter paper. Into one funnel put some clay and spread about very thoroughly, so as to leave no fissures through which water might run; into the other put some sand or sandy soil, and spread about equally well. Pour water into the funnels; it rapidly runs through the sand, but will not pass through the clay.

The explanation is not difficult to trace: water passes through sand because sand particles are large and have large spaces between them even with the closest packing; it will not pass through clay because clay particles are extremely minute and the spaces between are also small.

It is obvious that the permeability of any soil to water will depend on the relative proportions of the fine and coarse particles, and that, generally speaking, the fine particles exercise the predominating influence.

This property forms a convenient test for a clay soil. Of two soils treated in the above fashion the one which allows more water to pass through in a given time contains less fine and more coarse matter than the other.

We have seen that salt hastens the deposition of fine particles from the turbid liquid of Experiment 71. Lime can be shown to have the same effect. The experimental result suggests that salt and lime cause the minute particles to coalesce and form larger ones, which sink more rapidly. If this is so, the permeability to water should be increased by the same treatment.

Experiment 73.—Divide some clay into three portions, and knead up the first with about one per cent. of lime, the second with about one per cent. of salt, and leave the third untouched. Lay the separate portions on to funnels, as in Experiment 72, and take the time required for a given volume of water to pass through each. Note that both lime and salt increase the rate at which water passes through clay.

In carrying out comparative experiments, take care that the clay is well above the filter paper. If the water poured on can once get to the filter paper, it is likely to pass through fairly rapidly.

Experiment 74.—The converse process of "puddling" decreases the permeability of clay. Knead up clay very thoroughly under water, working it well with the fingers; you thus obtain a plastic mass which appears to be quite impermeable to water. Basins made of this material will hold water indefinitely. Puddled clay is valuable in making an embankment water-tight.

The impermeability of clay is also one of the factors which produce springs. There is a spring at Wye with which the school children were all acquainted, and by applying the method of Experiment 72 we were able to discover how it arose. The spring appears at the foot of the escarpment of the Downs, where a bed of clay comes from under the chalk and forms a strip two or three miles wide and many miles long. The chalk soil above the spring was found to allow water to pass rapidly through; the clay soil round about the spring was almost impermeable.

It was, therefore, concluded that the rain which fell on the Downs would readily soak into the ground until it came to this bed of clay, when it could get no farther. It then came out from the Downs, forming a spring. On the other hand, rain falling on the strip of clay could not easily sink in; it would lie on the surface, or run off in streams. Not only could we thus explain the formation of the spring, but we could also account for the entire absence of streams or even ditches on the Downs, for their frequent occurrence on the clay strip, and for the profusion of springs at the junction of the clay and the chalk.

When a natural phenomenon has been dissected in this way, or "analysed," the explanation put forward should always be tested by a reconstruction or "synthesis." A model was therefore made which should, on the above reasoning, act as a spring.

Experiment 75.—Knock out the side of a box and substitute three strips of glass fitting into wooden or lead pieces. Bore two of these in the middle, and fix in short pieces of glass tubing with putty; make the whole box quite water-tight with the same material. Bore some small holes in the bottom of the box.

When the box is finally water-tight and the putty is set, put in sand nearly to the level at which the lower tube is placed, then lay on this some well-worked clay, ramming it well into the corners so as to leave no spaces, but keep the top of the clay below the tube. Arrange also that the clay slopes down towards the tube. Fill in with permeable soil—we used actual soil from above the spring. Then run water on to the top from a watering can provided with a rose.

In our experiment nothing happened for a time. Then water began to escape from the lower tube, *i.e.* the one immediately above the clay, but none escaped from the upper tube, which was about half-way up the chalk soil. Discontinuing the water supply did not cause the lower tube to cease running; a continuous flow was obtained, although the supply was purposely made intermittent.

It was also noticed that little or nothing ran through the holes in the bottom of the box. The layer of clay held up practically the whole of the water which could not escape by means of the glass tube.

This reconstruction of the spring proved that the suggested explanation was correct.

COURSE OF LESSONS IN DOMESTIC SCIENCE.

THE FRAME AND MUSCLES.

Step I. Preparation.—In order to understand the proper action of the various limbs it is necessary that the children should have some knowledge of the lever. A lever is a rigid bar which is free to turn about some fixed point called the fulcrum. By applying a force to some other point in the lever, a certain weight may be moved, the amount of which will vary inversely as the respective distances of the force and the weight from the fulcrum.

Levers are divided into three orders according to the relative positions of the force, the weight, and the fulcrum.

First Order.—The weight and the power are at either end, and the fulcrum is somewhere between them. In raising the coals in the fire, the poker is used as a lever of the first order, for it rests on the bar of the grate which forms the fulcrum, the power is applied to the handle, and the coals are raised by the point. The crowbar, the common balance, the see-saw, are other examples of the first order of levers.

Second Order.—The fulcrum and the power are now at the ends of the lever, and the weight between them, as seen in a wheel-barrow, a pair of nut-crackers, or the oar of a boat.

Third Order.—The fulcrum is still at one end, but the power and weight have changed places, the former now occupying the central position, as in the case of the safety-valve of a steam-engine.

Step II. Presentation: *The Skeleton.*—The framework that gives strength and rigidity to the limbs, is formed of over two hundred separate bones, joined together by ligaments or by cartilages. These bones may be divided into six sets, one for each of the six great divisions of the body—the trunk, the head, and the two pairs of limbs. Should time permit these may be treated in detail, but space will not allow us to take more than a cursory glance at them.

The most important part of the skeleton is the vertebral column, or back-bone, which runs down the whole length of the trunk, and to which the bones of the head and limbs are joined. Were strength the sole object of the back-bone it would probably have been in one solid piece; but this would not allow us to stoop or bend the back in any way. So it is composed of no less than thirty-three separate bones—at least they are separate in youth, but in time the last four grow together into one piece, and so do the next six. These bones are held firmly together by ligaments, and between them are little pads of gristle, which act like the buffers of a train in breaking a sudden shock, and also give flexibility to the column by allowing a certain amount of play between the bones. Each bone is pierced by a hole, and when the bones are in position these holes form a hollow channel, through which runs the spinal cord. From the upper part of the back-bone spring the ribs, twelve on each side. These are bent round, and with the exception of the lowest two pairs they join the breast-bone, thus forming a kind of cage that protects the lungs and assists in the operation of breathing.

On top of the back-bone is the skull, which in youth consists of twenty-two separate pieces, most

of which grow together in the adult. The shape and structure of the skull fit it in an admirable way to perform its work of protecting the most delicate organs of the body. The brain is completely enclosed in a box of bone, while the organs of hearing and sight, which must necessarily be on the exterior, are situated in cavities which afford ample protection to them. This may be shown by pressing a stick across the eye, when it will be found that the pressure falls on the cheek and the eyebrow, while the eye itself is untouched.

The bones of the limbs are attached to the back-bone by suitable connections; those of the arms by the shoulder-blades and collar-bones; those of the legs by a more massive set of bones, the pelvis, which also serves as a support to the organs of the abdomen. There are altogether thirty bones in each of the limbs. The upper part of each limb is provided with one long bone of great strength, while the lower part has two, so, with the exception of the knee-cap, all the other bones are situated in the wrist and hand, or ankle and foot respectively.

Joints.—In order to permit of motion, these various bones are connected to form joints, which will allow the limbs to move freely in the directions in which they can best carry out their own particular functions. These motions are not all alike; thus the arm is capable of a circular motion at the shoulder, but at the elbow it can only move in one direction.

Imperfect Joints.—Such joints as those in the back-bone are called *imperfect*, because the bones do not move over one another, but a certain amount of motion is allowed by the flexibility of the pad of gristle which connects them.

Perfect Joints.—These are of various kinds, such as:—

1. The Ball and Socket. The head of the movable bone is rounded off, and fits into a cup or socket in the other bone, somewhat like a child's "cup and ball." A joint of this kind permits of motion in any direction, the distance to which the limb can move being limited by the depth of the cup. The shoulder and the hip are examples of ball and socket joints. The former has a very shallow cup, which allows the arm a large amount of play; but the latter has a deep cup, so that the thigh can only move a little way out of the perpendicular except in a forward direction.

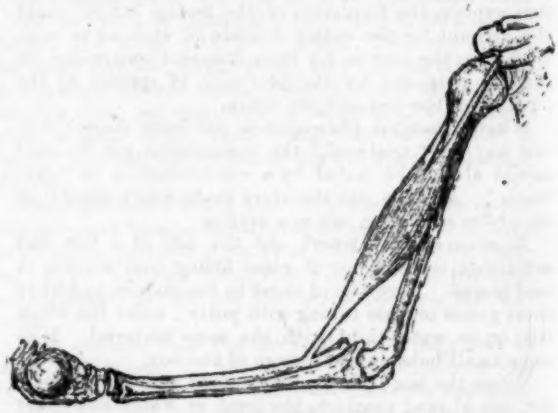
BALL AND SOCKET—THE HIP.

2. The Hinge. The elbow is a good example of a hinge joint. Here the head of the movable bone is cylindrical, so that motion can take place only in one direction. (A shoulder of mutton will furnish examples of both these joints.) The thumb is joined to the wrist by a double hinge, which gives it the combination of two motions.

3. The Pivot. The skull rests on the first bone of the spine with a hinge joint that allows the head to nod backward and forward. This first vertebra, however, is pierced by a hole through which passes a vertical peg which is part of the second vertebra, and acts as a pivot on which the head turns.

If a hinge is to work easily, the parts that move over each other must be very smooth, and should be oiled occasionally. So we find in the joints of the body, the ends of the bone are covered with cartilage to form a perfectly smooth surface, and further, there is a fluid continually being secreted, to lubricate them and make them move easily.

Muscle.—Let a boy roll up his sleeve, clench his fist and throw up his forearm. The flesh in the upper arm is seen to swell into a hard lump, which tapers off to either end, the lower end being seen to terminate just below the elbow-joint in a strong cord. This swelling is a typical muscle, consisting of a bundle of fibres or threads wrapped together in a sheath. The red lean meat at the butcher's shop is the muscle of some animal. This, however, has been cut, and a better idea of the shape and deposition of the muscles on the skeleton is obtained by examining some small animal, such as a rabbit, after it has been skinned. The muscles will be seen to taper off towards the ends, the fibres running together and forming a strong cord called a tendon.



THE BICEPS.

A diagram of a muscle, however rough, if it shows correctly the insertion of the tendons, will make clear to the children how the movements of the body are brought about by the contraction of the various muscles, and also how the bones of the limbs act as levers, the joint being the fulcrum and the muscle the power.

The order of lever varies according to the relative positions of the joint, the tendon, and the weight of the limb. The skull moving on the first vertebra, or the pelvis on the thigh bones, are examples of levers of the first order. When the thigh is lifted, or the body raised on the toes, we have examples of levers of the second order; while examples of the third order are seen in the raising of the forearm or straightening the leg at the knee.

Voluntary and Involuntary Muscles.—Most of the muscles of the body are under the control of the will, and are therefore called voluntary muscles; but there are also certain muscles, such as the heart, that contract without any mental effort on our part.

Step III. Association: *Growth of a Bone.*—A bone consists of mineral matter (mostly phosphate and carbonate of lime), bound together with animal substance. The former gives hardness and rigidity to the bone, the latter gives it strength and a certain amount of elasticity. If a bone is heated in a bright fire the animal matter may be destroyed. The white mineral matter that is left still retains the form of the bone, but is very brittle, and soon falls to pieces. On the other hand, the mineral matter can be dissolved out of a bone by means of dilute hydrochloric acid, and again we have the form of the bone left, but this time it is soft and flexible.. In extreme youth there is very little mineral matter in the bones, so the limbs have no rigidity. On this account children should not be allowed to stand until the bones of the legs have received sufficient mineral matter to make them firm enough to bear the weight. To those who care to follow up the subject, a bone affords a good example of the wondrous way in which Nature utilises her materials to the best advantage, obtaining a maximum of strength with a minimum of weight. Take the thigh bone, for example: the hollow shaft decreases the weight, and at the same time lessens the danger of fracture; whilst an examination of the mineral matter in a section of a burnt bone will show that it is carefully arranged in lines that will best meet the strain that will be thrown upon that particular part.

Step IV. Formulation.—*The Skeleton*, or framework of the body, contains over 200 bones.

The Trunk contains the back-bone (33 bones), the ribs (12 pairs).

The Head contains the skull, which protects the brain and organs of sight, smell, taste, and hearing.

The Limbs each contain 30 bones; the arms are joined to back-bone by the shoulder-blades and collar-bone, and the legs by the pelvis.

Joints may be perfect or imperfect.

Imperfect Joints are found between the vertebræ.

Perfect Joints may be

Ball and Socket, as the shoulder or hip;
Hinge, as the elbow or knee;
Pivot, as the skull and top vertebra on the second.

Muscle consists of a bundle of fibres wrapped together in a sheath. It is joined to the bone by tendons.

Step V. Application.—We have seen that the bones of an infant are soft and flexible, but gradually harden by the deposition of mineral matter. Hence it is important that growing children should try to acquire a proper carriage, and not get into the habit of stooping when sitting over their lessons.

A knowledge of the build of the body should lead the children to take a more intelligent interest in their physical exercises, which increase the working powers of the muscles. These exercises may be either recreative, as cricket, tennis, swimming, etc.; or educational. The latter are designed to afford well-balanced exercise to the whole body, whereas the former as a rule tend to develop one particular part, often at the expense of the rest of the body.

In taking exercise the following rules should be observed:—

1. The movements should exercise every part of the body.
2. The exercise should be systematic and regular.
3. The amount of exertion should be regulated to suit the strength of the individual, and must never be carried to excess.
4. Exercise should never be taken immediately after meals, and if possible it should be taken in the open air.
5. The clothing should be light, and must not interfere with the movements.
6. Care should be taken to avoid chill after taking exercise.

THE GEOGRAPHY OF PALESTINE.

BY J. F. UNSTEAD, M.A., F.R.G.S.,

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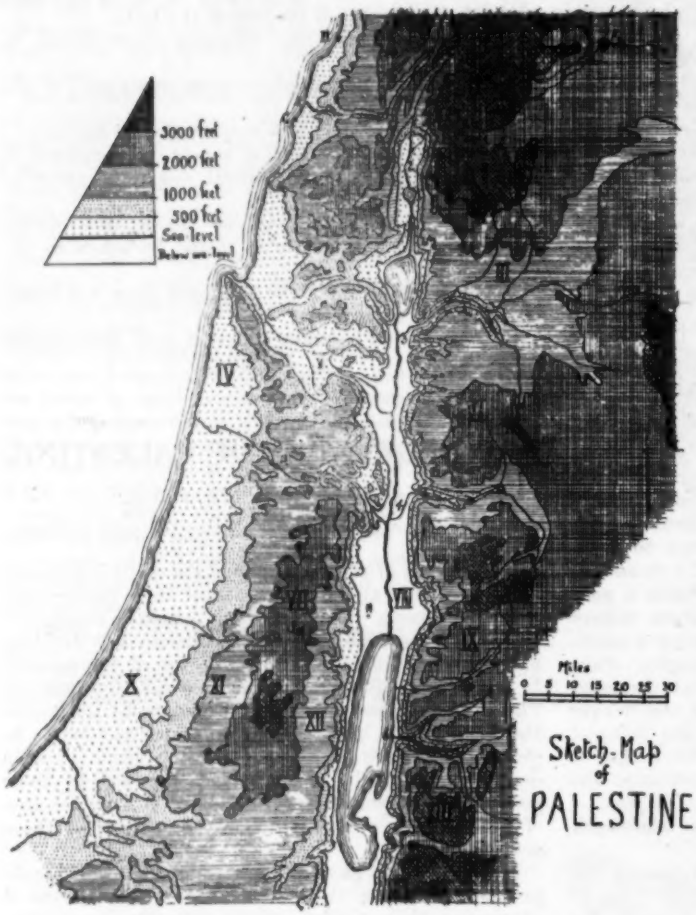
THIS study of the geography of Palestine is intended mainly as an aid to teachers of Bible History and Bible Literature. It is becoming generally recognised that it is impossible to study the history and development of a people without a knowledge of the country in which they lived, and their physical environment. This is so not merely because the geography illustrates the history, but because it is an important factor in controlling the history; the lines upon which a people develop are in a large measure determined by their geographical circumstances. To show this in the case of the Hebrew people is one of the objects of these articles.

Moreover, the physical environment of a people profoundly affects their literature. Their forms of expression, their similes and parables, are drawn from the world around them; even the thoughts themselves may be suggested by nature as it presents itself to them, or by the occupations in which nature permits them to engage. Yet the study of the manner in which the geography affects the literature is extremely difficult, and here we can do little more than point out some of the simpler instances.

In these ways the student or teacher of the Bible may be helped, and such aid is frequently attempted in "Bible Handbooks" and "Bible Notes," yet one must say that almost invariably the geographical side of such studies is incomplete and fragmentary. Our object here is to present a reasoned account of the geographical conditions which may in itself be an example of the "New Geography," looking not at isolated and unconnected phenomena, but tracing the connection between the different facts, and seeking to learn the causes and effects in an orderly manner.

Our first study then is *the relief of the land*—the arrangement of lowlands and highlands, of mountains and valleys. To study these a map is necessary, and

here again one must criticise the ordinary maps to be found in Bibles or used in Bible lessons. They show chiefly the steeper mountain slopes, but they do not show the comparative height of most of the land. If land is fairly level no markings are employed, and there is no indication whether that land is a deep depression a thousand feet below the level of the sea, a lowland plain at sea-level, or a high plateau three thousand feet above the sea. All these land-forms occur in Palestine, the differences between them are of the greatest importance, and yet the ordinary map takes no account of such differences. Therefore a sketch-map is here given to supplement the maps which are generally accessible. This map shows by means of various shadings the height of the ground above sea-level, or its depth below sea-level. It is termed an orographical map, and should be sufficiently explained by the scale attached, and by the section across the country. We shall see that the elevation of the ground affects the climate and productions, the occupations of the people, and the course of the history to an extraordinary degree, and so the mastery of the relief-map is a quite necessary preliminary to our study. The map does not show hill-slopes by the usual hill-shading, but the steepness of the slopes can be deduced from the closeness of the contour lines, which mark the height of the land. Where there is a considerable space between the contour lines the slope, generally speaking, must be gradual; where the contour lines run close together the slope must be steep, as a great rise is found in a very short distance. The different natural regions, and some of the rivers and towns, are indicated by symbols explained beneath the map, but the position of most places mentioned in the Bible should be found on an ordinary map, and then referred to this orographical one.



I. Mount Lebanon.
II. Mount Hermon (Anti-Lebanon).
III. Plateau of Bashan.
IV. Plain of Sharon.
V. Plain of Esdraelon.
VI. Mountains of Gilead.
VII. Mountains of Judæa.
VIII. The Great Depression.
IX. Mountains of Ammon.
X. Plain of Philistia.
XI. The Shephelah.
XII. Wilderness of Judæa.
XIII. Mountains of Moab.

1. River Leontes (Litany).
2. River Jordan.
3. River Yarmak.
4. River Jabbok.
5. Brook Cherith.
6. River Arhon.

A. Damascus.
B. Sidon.
C. Tyre.
E. Megiddo.
F. Dothan.
S. Samaria.
H. Jericho.
J. Jerusalem.

The *natural regions of Palestine* may perhaps best be described by considering some imaginary crossings of the country from west to east. If we take a line passing through Jerusalem, we find first a coastal plain bordering the sea, less than 500 feet high, and here about seventeen miles wide. This is Philistia, the land of the Philistines, a region never really conquered, and never occupied by the Hebrews. Further east is a mountain region twice as wide, and rising in the centre near Jerusalem to a height of about 2600 feet; this forms the Mountains of Judæa, the stronghold and the real home of the Jews—"I will lift up mine eyes unto the hills, from whence cometh my help." Looking at the map, we see that the mountains are continued north and south with but few breaks, and they may conveniently be called the Central Range, as they form the central portion of the land. Still farther westward we come to the most remarkable feature of the country, a deep trench with steep sides frequently precipitous, and its bottom not only far below the level of the surrounding land, but far below the level of the sea. It is the deepest depression on the face of the earth, and it runs throughout the country, sharply separating the main portion of Palestine from the part "beyond the Jordan." This low region is commonly called the Jordan valley, but that name is not very well chosen, for the depression has not been carved out of the land by the Jordan, as most valleys have been carved out by their rivers; its origin will be explained later, and the name of the modern Arabs, "El Ghor"—the Rift or Depression—is very suitable. At this point the Depression is about twelve miles wide, and nearly

1300 feet below sea-level, therefore about 4000 feet below Jerusalem. Bounding this on the east is another mountain region, the land of Ammon, forming part of the Eastern Range which runs parallel to the Central Range. Overlooking the Depression is Mount Pisgah ("Summit"), nearly on a level with Jerusalem. We may consider this mountain region to extend for some twenty miles eastward, and then at a slightly lower level is the great plateau of the desert stretching onward for hundreds of miles across Syria.

Taking another line farther south to cross the centre of the Dead Sea, we find only some slight differences. The width of the Central Range is greater, and the land between the contours showing 500 feet and 2000 feet respectively forms a region distinct from the coastal plain of Philistia on the one hand and the mountains on the other. This is the Shephelah, a hilly country, always a debatable land, and the scene of many conflicts between the Hebrews and the Philistines—a buffer-land, as it were. The Central Range here reaches a height of over 3000 feet near Hebron, and the Depression is deeper than to the north; for just as the Dead Sea surface is about 1300 feet below sea-level, so the bottom of the sea is at deepest about 1300 feet below the surface. Overlooking the Dead Sea on the east are the Mountains of Moab, over 3000 feet high. If we trace these features still farther southward beyond the borders of Palestine, we find that the coastal plain bends round to the south-west, skirting the Mediterranean Sea, and forming an easy route to Egypt. The Central Range broadens and continues into the peninsula of Sinai. The Depression also extends southward, at last forming a hollow which is filled with salt water from the Red Sea, and is called the Gulf of Akabah. The Eastern Range still overlooks it on the east, and the Desert merges into the great mass of Syria.

Hence we find that the southern part of the country is naturally divided into greatly differing regions each running north and south; but farther north the arrangement is less simple. Taking a line across Samaria, we find that the coastal plain is somewhat narrower, and here is called the Plain of Sharon, the Central Range is lower, the Depression is shallower, and the Eastern Range forms the mountains of Gilead in the neighbourhood of the river Jabbok.

But just north of this line is a region where the longitudinal arrangement of features is entirely broken, and this interruption has had a most marked influence on the history. The Central Range seems bent north-westward forming the spur known as Mount Carmel, which projects into the Mediterranean Sea with a headland 500 feet high. Therefore the Plain of Sharon first narrows and then is entirely cut off from the more northern lowlands.

Just as the mountain range of Carmel is a violation of the general north-and-south run of the features, so the plain which it overlooks on its north-east side is a similar anomaly. This plain leads from the Mediterranean through to the Great Depression, with a continuous stretch of lowland less than 500 feet above sea-level. The lower part of the lowland leading down into the Depression is the Valley of Jezreel, and the general term for the whole region is the Plain of Esdraelon. Flowing from Mount Gilboa, along the plain under the edge of Mount Carmel to the sea, is the river Kishon. Here was the scene of Barak's victory over Sisera, and here indeed occurred several other historic events. As will be shown later, this plain is the central part of the great route from Egypt along the Plains of Philistia and Sharon, through the Plain of Esdraelon, across the Depression south of the Sea of Galilee, north-eastward to Damascus and thence to Mesopotamia. Trade route and war route from the beginning of historical time, this road has contributed many a setting to great dramas of human intercourse and strife. Two instances may be mentioned which in themselves give point to two important geographical facts.

It will be noticed that from the Plain of Sharon to the Plain of Esdraelon there are two gap-ways below 1000 feet high—the narrow north-west one near Megiddo and the wider south-east one at Dothan. About 610 B.C. the King of Egypt wished to share in the spoils of the Assyrian Empire, then near its fall, and marched northward into Palestine. Josiah, King of Judah, thought that this meant the conquest of his own country, and attempted to defend the pass at Megiddo. A terrible battle was fought, as a result of which Josiah was slain and Judah became a mere vassal state of Egypt. The other pass, that at Dothan, was the scene of the traditional story of Joseph's sale by his brethren to a party of Midianites who "came from Gilead with their camels, bearing spices and balm and myrrh, going to carry it down into Egypt."

North of the Plain of Esdraelon, the coastal plain disappears as a whole; the mountains of Lower Galilee are not high, and leave a fairly wide lowland between themselves and the sea, but in Upper Galilee they are higher, and frequently approach the coast, sometimes scarcely leaving a roadway. The plains here are mere pockets of lowland caught between the mountain spurs. This coastal region was Phœnicia, the land of Tyre and Sidon, a land of traders, and never under the Hebrews In fact one may say that scarcely ever did the Hebrew race have possessions on the coast, and it is noteworthy that the ships of Solomon—under whom the dominions were greatest—sailed from the ports on the Gulf of Akabah, and not from Mediterranean ports. North of Galilee the whole land is higher; there is still the distinction between the Central Range, the Depression, and the Eastern Range, but they are all at a far higher level. The Central Range becomes Mount Lebanon, and reaches a height of nearly 9000 feet, the Depression becomes the Bekaa—or Cœle-Syria—itself 2000 feet above sea-level; and the Eastern Range becomes the Anti-Lebanon Range, which is highest in Mount Hermon, considerably above 9000 feet high. Just east of Anti-Lebanon, between the mountains and the desert, lies Damascus, one of the oldest cities in the world—the "Eternal City" it might indeed be called. One more region remains for notice, that immediately east of the Sea of Galilee. This is the plateau region known as Bashan, Hauran, or Decapolis, and is essentially the basin of the river Yarmuk, which obtains its water from mountains surrounding Bashan on the north, the east, and the south.

Although it is convenient to consider the relief of the land first, as has here been done, yet adopting a strictly logical arrangement, we should have examined first that feature of the land which determines the relief, namely *the geological structure*, *i.e.* the kinds of rock forming the ground, and their arrangement. The greater part of the country is composed of limestone laid down when this portion of the earth's surface was beneath the sea, and afterwards upheaved to form dry land. Had this upheaval taken place without other movements, we might have seen a highland region

rising gradually from the Mediterranean Sea eastward, with a mountain crest running north-and-south somewhere in the position of the Great Depression, and forming a rim to the desert plateau behind. But the pressure was too great for the rocks, and under the strain they gave way; a great crack, or "fault," as it is called, was formed in a north-and-south line, where is now the eastern edge of the Depression; then the pressure probably caused the rocks to be uplifted on the eastern side of the fault, while those on the western side dropped down along this line, and were upheaved farther west to form the present Central Range. In places the bending of the western rocks caused subsidiary faults to be formed parallel to the primary line, and these may account to some extent for the steepness of the western edge of the Depression. (See the geological diagram.)

Long after this the whole region sank down, and the sea covered the lower portions. The present coastal plains and the Plain of Esdraelon were covered, and the Great Depression was filled with water. Consequently deposits were laid down under the water over these submerged portions. Later the whole region was uplifted, and these lowlands emerged covered with soft materials which now form a soil much more fertile than the limestone of the higher ground. This limestone is composed of layers of varying hardness, and throughout many thousands of years it has been exposed to the wearing action of the wind and rain, of temperature changes and running water. Hence on the crest of the Central Range the chalky upper portion of the series has been worn away, and the harder lower part forms a ridge of rugged mountainous country. In other parts, *e.g.* the Shephelah, the chalky layers remain, and form hills of rounder outline.

While these great earth-movements were in progress, volcanic agencies were active, and portions of the country were then covered with flows of lava, which when "weathered" afford a fertile soil. Hence it appears that the movements of the earth's surface, long ages ago, have resulted in the present relief of the land, and have, as we shall see, a great effect on the vegetation of to-day.

The *climate of the country* under the three heads of temperature, winds, and rainfall may now be considered. First let us study the temperature at Jerusalem, on the crest of the mountains of Judæa; there is an average temperature of 45° Fahr. in the coldest month, and 76° Fahr. in the warmest month. To help to appreciate this, one may mention that the corresponding temperatures for London are 38° and 64°; hence it is at all times of the year warmer in Jerusalem than in London, but especially in summer. The nearest parallel seems to be the temperatures at Rome, which are about 44° and 76°. But Jerusalem is on a mountain range, and yet has the same amount of heat as Rome, which stands almost at sea-level. One reason for this is that Palestine is between latitudes 31° N. and 33° N.; it may not be generally realised that Jerusalem is as far south of Rome as Rome is south of London. Coming down from Jerusalem to the coastal plain, higher temperatures are experienced, for the general rule is that every 270 feet of descent adds 1° Fahr. to the temperature, and similarly, after descending into the Great Depression really tropical conditions are met with. Here it is hot not merely because there is an additional descent of about 1300 feet, but also because the sea-winds, which cool the air in summer, pass over the Depression, leaving its depths windless.

Exposed to the blazing sun of the cloudless summer, the valley is almost unbearable; there are but few towns in the region, and the inhabitants are enervated and weak. For example, the town of Jericho has again and again been taken by the hardier hill-men or desert raiders, and the impotence of its inhabitants was such that it needed but little poetic or traditionary exaggeration for the account of how, at the shouting of an invading army, "the wall fell down flat, so that the people went up into the city every man straight before him, and they took the city."

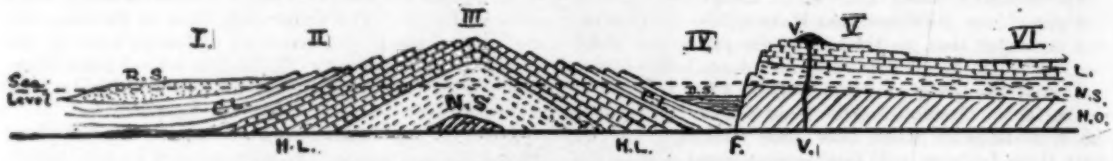


DIAGRAM ILLUSTRATING THE GEOLOGICAL STRUCTURE OF PALESTINE.

I. Coastal Plain. II. The Shephelah. III. Central Range. IV. Great Depression. V. Eastern Range. VI. Desert Plateau.

R.S. = Recent soft deposits. C.L. = Upper chalky limestone. H.L. = Lower harder limestone. N.S. = Nubian sandstone. H.O. = Harder and older rock. F. = Fault. V. = Volcanic outbreak. D.S. = Dead Sea.

The summer heat of the land is one of the chief factors in determining the winds of that season. The air over the land is in the daytime heated more than that over the sea. Hence there is a "sea-breeze" blowing usually from the north-west and cooling the land considerably. This is felt near the coast in the morning; during the day its power increases, and the highlands in the trans-Jordan region are affected; in the evening it dies away. This air coming from the Mediterranean Sea contains water-vapour, and usually, when air is forced up to cross mountain regions, it is cooled as it ascends, and its water-vapour is condensed to form rain. But in this case the air receives so much heat from the land over which it passes that, in spite of the ascent, the temperature is not lowered so as to cause condensation; hence the summer is practically rainless. At night the sea-breeze ceases, the air becomes cooler, and much dew is deposited. This dew is of great importance; frequently it is very heavy, and it is the salvation of such vegetation as manages to exist during the parched summer; its importance is suggested by the phrase, "There shall not be dew nor rain these years."

The winter conditions are entirely different. The daily "sea-breeze" is not observed, and the winds come from various directions. Sometimes they come from the desert in the east, bringing dust and sand—this, however, chiefly in spring. Frequently they come from the west and the south-west, and these are the winds

upon which the people depend for their very livelihood, for these sea winds bring water-vapour, and in this winter season it is condensed when the winds are cooled by ascending to cross the higher grounds. If, then, we imagine winds coming from the west and the south-west, laden with moisture and shedding rain on the high grounds over which they pass, we can find, by referring to the orographical map, the relative amount of rainfall in different parts of the country. The extreme south of Palestine scarcely comes under the influence of these winds, and has but little rain. Philistia and the Central Range behind get a moderate amount, Jerusalem receiving about 25 inches in the year—that is, about the same amount as London, but with this difference, that London gets its rain well distributed throughout the year, while Jerusalem receives it nearly all in the six months November to April. The slopes from Jerusalem down to the Jordan have very little rain, for the air descends and is thereby warmed, and in the Jordan valley there is much evaporation, but practically no condensation of moisture. The mountains on the eastern edge of the Depression get some rain, but the desert beyond of course is almost rainless. That is the reason why it is a desert, and where water is found in occasional wells fertile oases occur. Farther north the rainfall is greater than in the part just considered. The slopes of Mount Carmel face the rain-bearing winds and are well watered, and all the mountains of the north have a fairly abundant supply on their seaward slopes and summits, but there is a comparative lack throughout the Great Depression and behind the ranges.

As a considerable portion of the country is just on the margin of a sufficient rain-supply, a season which has less than the normal amount makes a vital difference; and so droughts and the consequent famines play an important part in the lives and thoughts of the people. The rainy and dry seasons, too, have frequent mention in the literature, *e.g.* "Lo, the winter is past, the rain is over and gone."

This seasonal distribution of rain in conjunction with the kind of ground has a marked influence on *the rivers and drainage systems* of the country. It should be remembered that most of the country is limestone, through which water sinks easily; therefore much of the rain, instead of running over the surface and forming rivers, sinks into the ground, giving rise to underground streams, which sometimes appear as springs at lower levels, sometimes afford water for wells, and sometimes reach the sea without appearing above ground at all. In many cases it is only after heavy rains that stream-channels contain water, and most of the rivers run dry in the summer. There are but few rivers that can be relied upon throughout the year, and the chief of these is of course the Jordan. This is a perennial stream, mainly because its sources are in the high mountains of the north; Hermon is snow-covered in the winter, and the snow is only gradually melted during the summer, thus giving water when the rains have ceased. Therefore in spring, when much snow is melted, the Jordan is subject to floods; "Jordan overfloweth all his banks all the time of harvest"—spring being, as we shall see, the time of harvest in a country of winter rains.

Even in ordinary times the Jordan is not navigable; it flows along a bed which quickly decreases in elevation down to the Dead Sea, and it has numerous rapids; consequently it is not suitable as a means of transport. Moreover it is too deep to allow easy crossing from one side to the other except at a few fords, and these fords have caused several important incidents in the history. Frequently the fords were held by people wishing to prevent the crossing of their enemies, and consequently they have been the scene of many battles. But if the Jordan is poorly suited for navigation, still less suited are the streams which enter it on either side. They are naturally torrential, as they descend rapidly from the Highlands into the Depression, and so have worn deep channels in the ground. This action is common to all swiftly-flowing rivers, but in most countries the sides of the valleys thus formed are worn away by "weathering," due chiefly to the action of water in the forms of rain, water retained in the soil, and small tributary streams. But there is very little rain in the great hollow between the Central and Eastern Ranges, the "weathering" of the sides of the valleys is very slight. Consequently the rivers cut deep and narrow ravines and gorges, and there results a wild type of scenery which may sometimes be impressive, but can scarcely be called beautiful.

In connection with the Jordan it should be noticed that almost all the important streams drain into this river, and that the final destination of these waters is the Dead Sea. Thus the river system is mainly one of inland drainage, and has not the importance which rivers draining into the ocean have as a means of communication; that is to say, the river valleys are not here, as elsewhere, the natural roadways of the country. Since the Dead Sea receives this water, which has dissolved in it salts obtained from the land through which the streams have flowed, it is constantly obtaining a store of these salts. On the other hand, it is subject to a great amount of evaporation of pure water, and therefore the mineral salts accumulate, and at the present time it contains more than 25 per cent. of these constituents. Hence the absence of life in the "Dead Sea," and because of the absence of fish, birds which prey upon them cannot live here.

Another point in connection with the drainage system should be noted. The limestone is often composed of harder and softer layers alternately, and the water dissolves or washes away the less resistant parts, thus causing large underground channels, and in places large caverns. These are characteristic of limestone regions in various parts of the world. Such caverns were in Palestine used as storehouses, and in times of need as places of refuge. In this way the geology explains the frequent reference to caves, and one remembers the exploits of David in caves, the size of which is exemplified by the statement, "David . . . escaped to the cave of Adullam . . . and there were with him about four hundred men."

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"WHAT MEAN THESE STONES?"

THE STUDY OF ARCHITECTURE IN ITS RELATION TO HISTORY.

BY EDMUND A. GREENING LAMBORN,

Headmaster S. Mary Magdalene Schools, Oxford.

(*Continued from p. 82.*)

THE ROMANESQUE STYLE.

Saxon and Norman Architecture.

The Outward Visible Signs.

WE have said that this style, of which the essential characteristic was the Round Arch, was evolved and developed from the Roman models in the centuries following the fall of the Roman Empire—the fifth to twelfth centuries A.D. By the peoples of Eastern Europe who were nearer to "the culture and civilisation of the Province," it was developed much earlier than by the western nations, and carried to greater perfection. The Crusaders of the late eleventh century profited by this fact, and brought home with them to the west much lore of building construction, and of the principles of decorative art, with, perhaps, some Byzantine workmen also. As a result, the ruder western Romanesque work of the style known as Early Norman or Saxon, was improved in the following century into the rich Norman style of Henry the Second's reign. The Eastern Romanesque or Byzantine style is distinguished by the invention and use of the dome or cupola, but this was not copied by the western nations until the revival of the eastern styles in the sixteenth century. The plan of the Byzantine churches was that of a cross, the dome covering the centre where the four arms met. The western peoples adopted the same plan of a church with nave and chancel, with transepts placed across, but substituted a central tower for the dome. With this account we may dismiss the Eastern Romanesque and proceed to consider

The Western Romanesque Style,

of which there are two stages, the Saxon Style and the Norman Style.

The Saxon Style.

Mainly 1050–1100, with a few traces of an earlier Anglo-Saxon Style.

At the time of the Anglo-Saxon occupation of Britain the heathen English, being far less civilised than the Romanised Britons, refused to adopt the architectural, as the religious system of the race they despised, and, burning the buildings which the Romans had erected in the country, continued to build their dwellings of wood as their rude forefathers had done in North Germany. When Christianity was re-introduced by Augustine, and Roman civilisation followed in its train, the English were very slow to copy the stone buildings of Eastern Europe, and their early churches were all built of wood. So we find continual references in the Saxon Chronicles to the destruction of churches by fire, and the ease with which the Danes fired the churches and abbeys is explained by the same fact. Glastonbury Abbey, of which Dunstan was abbot, and which was one of the most important in England, was built of wood, covered outside with sheets of lead, and lined inside with gold and silver. This was so, even down to the middle of the eleventh century, for Canute's charter granted to the Abbey in 1032 was dated from the *wooden* church there.

The Saxons, however, certainly built *some* stone churches. It is recorded that Alfred built some, and that Canute ordered stone churches to be built in some of the places where his forefathers had burnt wooden ones. But as they were very few, and were generally pulled down by the Normans, who in their enthusiasm replaced them by larger ones, there are scarcely any churches existent which one can state positively to belong to the Saxon period. Of these, the small church at Bradford, Wiltshire, is certainly one, the tower of Monkwearmouth church is probably of this date, and there are crypts in churches at Ripon and Hexham which may have belonged originally to Saxon churches. As these remains are so few we can say very little about this primitive English style, but the masonry appears to be of much better quality than was the case in the eleventh century, to which most of the buildings in what is known as the Saxon Style probably belong. All these eleventh-century churches were most likely built under Norman influence, even if they were not, as some think, built in the years immediately following the Norman Conquest. In either case, they would be built by Saxon workmen, supervised by Norman masters. The characteristics of this eleventh-century work are as follows.

Imprimis, the most important remains of work in this style consists mainly of towers. These towers are built in very rough style with rubble (*i.e.* of stones unsquared by the mason; masonry with squared stones is known as ashlar work). This rough masonry was originally plastered over within and without, and the quoins (or corner-stones) usually bear traces of this in the chippings by which the surface of the stone was artificially roughened so as to hold the plaster better. They are built without stairs, the construction of a newel (or spiral) staircase being a matter beyond the rude skill of the early builders. They usually taper, or batter as the term is, slightly from base to top, but sometimes, as at Earl's Barton, diminish by stages. They are without buttresses and un-battlemented, having thus a very plain effect. (See Fig. 25.) There is one characteristic of the construction of these towers by which any of them may be immediately identified. In building with rubble it is necessary to have a certain number of *squared* stones in order that the corners of the building may be true. As the facilities for squaring stones were very limited at that early period, and the masons had little skill, the squared stones available were arranged at the corners, as shown in Fig. 19, every alternate stone being placed with its greatest length in a vertical position so as to give the greatest length possible for a given quantity of stone. This arrangement is known as "Long-and-short work," and its presence practically fixes the date of a building as eleventh-century.

Another peculiarity of eleventh-century masonry (though not absolutely confined to that century) is Herring-bone work, rubble masonry in which the stones are laid aslant instead of being bedded flat.

An example of this may be seen in Bampton Church, Oxon, and a drawing is shown in Fig. 20. Yet another distinctive feature in some towers of the Saxon type is the presence on the face of a tower of a sort of skeleton

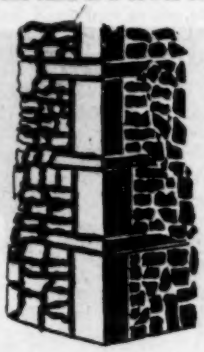


FIG. 19.—Long-and-short work, S. Michael's, Oxford.

framework of squared stones filled in with rubble, as at Earl's Barton, Northamptonshire. It is considered probable that this framework, running up and across the face of the tower like beams and posts, was intended

FIG. 20.—Herring-bone work, Bampton, Oxon.

to imitate the Saxon timber buildings, and the term "stone carpentry" has been applied to it. But it is perhaps more likely that these strips, like the later Norman buttresses, are rude imitations of Roman

FIG. 21.—A Saxon window, Barnack, early 11th century.

pilasters decorating the front of the building. (In the photograph of the Ashmolean Museum, Oxford, which appeared in the last paper (Fig. 7), a flat Classic pilaster

FIG. 22.—Plan of a Saxon window showing inside and outside splays.

FIG. 22*b*.—Plan of post 11th century window with inside splay only.

may be seen on the face of the wall to the left of the portico.)

The arches of windows and doorways in the Saxon Style were of course round, extremely plain, and almost always without mouldings. Very small windows have heads formed by two long stones inclined together at

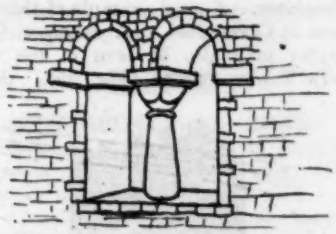


FIG. 23.—Saxon double window in belfry of North Leigh Church, Oxon, showing baluster shaft, 11th century.

an angle, as in the small window in Barnack Tower (Northampton), shown in the drawing (Fig. 21). In

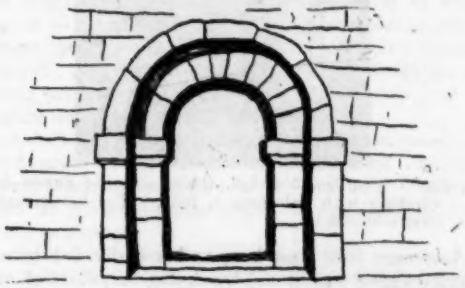


FIG. 24.—A Saxon doorway, Earl's Barton, showing the rude massive masonry characteristic of the 11th century.

Bicester Church, Oxon, one of the arches of the nave arcade is formed in this way, but large arches of this

FIG. 25.—S. Michael's Tower, Oxford, showing Long-and-short work, rough rubble masonry, rude round-headed windows and balusters, *c.* 1050.

type are extremely rare.[1] None of the windows are large, and a distinctive characteristic is that they are

[1] It is a disputed question whether this arch is really Saxon work or, as the Vicar of Bicester thinks, a makeshift of later date.

splayed both without and within, so that the opening of the window and the glass, if any, is in the middle of the thickness of the wall, and not at its outer surface, as was the case later. A good example of this peculiarity may be seen at Caversfield, near Bicester, Oxon. The external splay may also be seen in the windows of S. Michael's Tower, Oxford (Fig. 25). Some belfry

FIG. 26.—Tower, North Leigh, Oxon, showing Saxon double windows with balusters, *c.* 1050. (The battlement is a later addition.)

windows are long and low, and are divided into two or more lights (divisions) by shafts, or pillars of stone, resembling the pillars in the balustrade of a bridge or balcony, that is, they look as if they had been turned in a lathe, being thick in the middle and tapering to each end. These are known as "baluster shafts," and form a ready means of identifying work of this period.

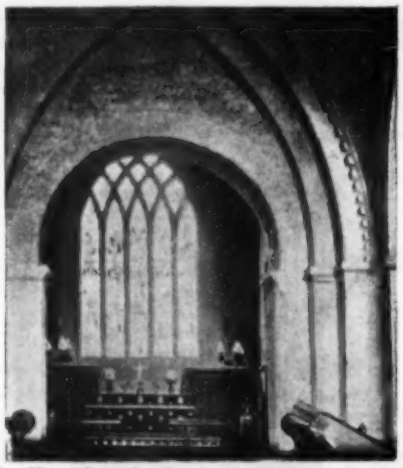


FIG. 27.—Chancel arch, Bampton, Oxon, probably Saxon, *c.* 1080. The pointed arch above is Transition Norman-Early English, *c.* 1180. (The window with crossing mullions is Decorated Gothic, *c.* 1320.)

There are examples in the tower of North Leigh Church, Oxon, and in S. Michael's Tower, Oxford, photographs of which are given (Figs. 23, 26).

During the Conqueror's reign the Normans were too busily engaged in military affairs, and in the settlement of the country, to modify very greatly the Rude Romanesque Style of architecture, but in the last decade of the eleventh century their genius and enthusiasm was turned in the direction of architecture, and the growing influence of the Church in the land may be seen in the foundation of the numerous churches

FIG. 28.—Norman and Saxon arches, Bicester. The small flat arch may be 10th century; the round arch is Norman, *c.* 1100. (The window is Perpendicular Gothic, *c.* 1450.)

in the pure Norman Style, which in the course of the next century was to develop into the perfected Western Romanesque, and eventually to give birth to the greatest of architectures—the Gothic Style.

(*Next month: The Norman Style.*)

REGULATIONS FOR SECONDARY SCHOOLS.

GEOGRAPHY (*continued from p.* 86).

THIRD YEAR—TERM I.

(A) Revision and General.

HALF-WAY through the course is a happy time to review the portion of the syllabus with which the student has already dealt. Really to do so effectively provides sufficient work for the term, but the demands of (B) will allow only very brief revision if there is to be any consideration of new points arising during the previous terms' work.

It is an excellent plan to encourage students diligently to watch the daily and periodical press in search of new geographical information. The main facts of physical geography are more or less stereotyped, but on every hand occur social, industrial, and political changes. Sometimes these occur with startling suddenness; at others they are but the crystallisation of movements initiated perhaps long years ago. Such information collected by the students and summarised for class use makes an invaluable addition to the text-books, which on many points are soon almost hopelessly out of date.

Revise chiefly from the standpoint of the human aspect, a consideration of what the peoples are doing by their labour in the upbuilding and exploitation of their national heritages. In all civilised countries at least the degree of industry is the keynote to the life of the nation. Call into constant requisition such annuals as the *Statesman's Year Book*, *Whitaker's Almanack*, *Hazell's Annual*, and the *Daily Mail Year Book*. Statistics to show the degree of industrial and com-

mercial activity must be dressed attractively by the teacher in the shape of simple graphs and diagrams, and the students may add others according to their own ideas.

Take the United Kingdom as the standard, and draw comparisons with other peoples in Europe, America, and Africa, perceiving how some threaten to outpace us, and have done so in some departments, and how others lag behind. There will be opened up endless channels for profitable exploration, such as the effect of climate and environment on food and occupation; the formation of national characteristics by environment and occupation, etc.

In the United Kingdom discuss such subjects as the unemployed problem; depopulation of rural areas; Protection *v.* Free Trade; the immigrant alien, etc.

Of Continental countries, Russia, Germany, Austria-Hungary, and Turkey claim special attention. The seething state of Russia and her potentialities of success when her present troubles are surmounted. Germany's boundless ambition, and especially her commercial rivalry with Great Britain. The dissensions between Hungary and Austria proper. The evil rule of the Turk, and the general unsettlement of the Balkan States. Endeavour to picture the map of Europe fifty years hence, *e.g.* Denmark and Holland in the hands of Germany, Belgium attached to France, and the Turk banished to Asia Minor.

In North America the phenomenal rise and progress of the United States will provide almost endless scope for consideration. The export fruit trade and its promise of financial salvation to the West Indies. Brazil, Argentina, and Chili will demand special attention.

Particularly discuss the Panama Canal and its effects on the great world routes, specially noting the advantages to the United States in the saving of distances.

Africa affords a wealth of material for revision and amplification, *e.g.* the New Egypt. South African problems—New Constitution for the Transvaal; Chinese labour; the extension of the railway *via* Victoria Falls; Natal and its native troubles, etc. The Congo Free State. Morocco, etc. etc.

(B) Flora and Fauna, with Special Reference to Environment Basis; Climatic Zones.

Flora.

The flora of the world affords immense scope for varied treatment. The method of dealing with the subject is largely a matter for individual taste. Some teachers may take the world as a whole, while others may prefer to take the flora continent by continent. The most effective is to treat each important product separately, leaving those of lesser importance for more general treatment. The Atlas of Commercial Geography (Cambridge University Press) contains a series of six useful maps showing the principal areas of—(1) Wheat and rice. (2) Barley, rye, oats, and tobacco. (3) Maize and cotton. (4) Potato, date, coconut, sago, and pepper. (5) Tea, coffee, vine. (6) Sugar (cane and beet), cacao.

Point out how plants have wandered from their natural habitat, and especially owing to the restless activity of the white man, *e.g.* wheat, potato, and describe the present attempt to cultivate cotton in different regions of the British Empire.

Note in respect of environment that while purely tropical products cannot succeed in temperate regions, the originally temperate flora will succeed in tropical regions at elevations securing at least something akin to its home temperature.

Breadstuffs.

Staple food of millions in the tropical regions—coconut, date, sago-palm, bread-fruit, banana. Enervating effect on people who obtain food, clothing, and shelter with the minimum of effort.

Cereals.—Great bulk of mankind supported on cereals. Cultivation of *wheat*, a world industry. Calculated 520 million wheat-eaters, annually swelled by further 10 millions. The tide of the wheat harvest round the world. Cultivation in Europe; high yield per acre in Great Britain and Denmark compared with crude methods in Russia. Russia's surplus of wheat owing to people eating rye. The American granary; the huge operations. Wheat elevators. The Chicago wheat-pit; the Baltic Corn Exchange. Britain's decreasing acreage under wheat; her dependence on the foreigner for her cheap loaf.

Rice.—Staple food of one-third the human race. Its limited area owing to its requirement of abundant moisture and temperature of 60° to 80°. Its little service in colder regions owing to its deficient flesh-forming property.

Barley.—Its wide distribution. Will ripen as far north as 70° in Norway, and at 11,000 feet elevation in the Himalayas.

Rye.—Ease with which grown; its resistance to frost. Second only to wheat as bread plant in Europe.

Oats.—Half the land devoted to cereals in Great Britain yields oats. Less nutritive than other cereals, but greater yield per acre.

Maize.—The only native cereal of America. Still the chief crop there, where it is called "corn." The yield exceeds wheat by four times. The use of maize flour in Italy for *polenta*, a kind of porridge. South African mealies.

Millet.—Its importance in India, China, and Egypt. In Egypt known as "durra"; in West Indies, "guinea corn."

Miscellaneous Foodstuffs.

Potato.—Native of South America. Its successful transplantation to every part of the civilised world. Its importance in Ireland; yield equals half a ton per head. In Germany it forms five-eighths of the food of the poorer classes. Its liability to disease. Potato famine in Ireland.

Sago.—Sago-palm easily grown; ten days' labour ensures food for a year. One tree will yield 400 lbs. of pith. Sarawak supplies half the world.

Tapioca.—Chiefly root of the manioc or cassava plant. Liquor expressed from the root is poisonous. Made into a starchy meal, and then forced through a sieve, but not so regularly granulated as sago.

Arrowroot.—Obtained from the cassava and other plants. Jamaica and Bermudan the best. A passable product yielded by the potato.

Sugar.—Its importance as an article of food. Consumption 80 lbs. per head, and import 36,000,000 cwt. in British Islands. The sugar cane and its introduction into America. Slave labour. Slave emancipation and

its effect on planting. The Napoleonic wars and doubtful supply of colonial produce. The rise of beet sugar. The sources of supply.

Fruit.—The delicious fruits of the tropics—banana, bread-fruit, mango, mangosteen, lime, pine-apple, etc. The fruits of the temperate regions—grapes, orange, lemon, olive, peach, apricot, apple, pear, cherry plum, strawberry, etc. etc. The demand for fruit among civilised peoples. The shortage of supply. Fruit-growing for export—California, Canada, Australia, New Zealand, etc. Fruit-tinning. The popularity of the banana. Raisins, currants, dates.

Drinks.

Non-alcoholic.

Tea and the sources of supply. Success of tea-planting in India and Ceylon, and its ousting of the Chinese product in British markets. Maté or Paraguay tea.

Coffee.—Native of Abyssinia and Arabia; now largely in East Indies and Brazil. Coffee-planting in Ceylon; its sudden failure. Replaced by tea. Small consumption of coffee in United Kingdom compared with tea, which is now 6 lbs. per head.

Cocoa.—Wide distribution. Caraccas the best. Its importance in Trinidad. In 1854 the consumption of cocoa in the United Kingdom was but 2½ oz. per head; now 20 oz., but probably accounted for by the popularity of chocolate sweetmeats.

Alcoholic.

Wine.—Vine almost as wide a range as wheat. Central and Southern Europe vineyards. Mention the best-known wines and where produced. The rise of Californian, Australian, and South African wines.

Spirits.—Brandy, whisky, rum, gin; the production of each from wine, barley, sugar, and rye respectively. The great distilling centres. Other national spirits, as vodka (Russia), raki (Balkan Peninsula), arrack (Southern Asia and East Indies). Liqueurs.

Beer.—Popular drink north of 50°. Ingredients and manufacture. Brewing industry in United Kingdom, especially Burton. The hop counties. The consumption of strong drink in the leading civilised countries.

Cider. Perry.

Materials for Manufactures.

Grasses, leaves, fibres, bark, etc., are invaluable in the production of textiles.

Cotton.—The demand and supply. United States, India, and Egypt the great sources of supply. Lancashire's dependence upon the United States. The industrial importance of cotton. The attempt to obtain British-grown material to counteract evil effects of cotton speculation.

Flax.—Linen manufacture. Decrease in acreage under flax in Ireland. The competition of the Baltic countries' product. Linseed and linseed oil; oilcake for cattle.

Hemp.—Sources of supply. Its greater strength than flax, and consequent importance for rope, cables, sail-cloth, etc.

Jute.—Its wide range of usefulness from cordage and gunny bags to its mixture with silk.

Other useful *fibres*, as *henequen, sisal hemp, China grass, coir*, etc.

Materials from the Forests.

Timber.—The immense varieties. The serviceable timbers of temperate regions, oak, pine, spruce, etc. The fancy woods of the tropics. The lumbering industry in Canada. Wood pulp. Douglas fir and cedar. Teak. Mahogany. The bamboo and its great utility. Jarrah, for wood paving.

Tar, pitch, turpentine, resin. Cork. Gambier. Cutch.

Miscellaneous.

Rubber.—The increased modern demand. Sources of supply. Rubber-planting. Conservation of rubber trees. *Guttapercha.*

Vegetable Oils.—Palm oil. Oil nuts. Olive oil.

Dyes.—Indigo; competition of chemical dyes. Madder. Quercitron. Sumach. Logwood. Brazil-wood. Fustic.

Drugs.—Medicinal substances, such as camomile, castor oil, senna, liquorice, sarsaparilla, ipecacuanha, quinine, eucalyptus, etc.

Tobacco.—How tobacco has conquered the whole world. Where cultivated. Noted areas. Importance as a source of revenue. Government monopolies.

Opium.—The Indian product. Government supervision. The traffic with China.

Flowers.—British demand. The Scilly Isles. Imports from France into England. Flower-growing for perfumes in South of France, Asia Minor, Turkey, and Persia. Attar of roses. Eau de Cologne.

Fauna.

Wild animals, reptiles, insects will be best treated continent by continent. Though possessed of voluntary motion, they are more or less restricted to particular regions, especially owing to the limitations of their diet. In some civilised regions the wild animals have become nearly if not quite extinct.

The domestic animals claim very special attention. They are now cosmopolitan, thanks to the domination of the white man over vast areas. Discuss the case of Britain, where industrial activity has caused dependence upon other countries for supply of *meat.*

The live stock of the chief countries. The flocks and herds of the United States, Canada, Argentina, Australia, and New Zealand. The import of cattle into the United Kingdom. The stock-yards and slaughter-houses of Chicago. The transportation of meat—beef from America, and mutton from Australasia. Tinned meats.

Dairy Produce.—The chief dairying countries. The Danish co-operative system. Eggs. British imports. Tinned milk. Refrigeration and cold storage.

Animals for Traction and Transport. Horse. Ass. Mule. Ox. Camel. Yak. Llama. Elephant. Reindeer.

Fish and Fisheries.—The chief edible varieties. The British fisheries. The denudation of the North Sea. Steam trawlers. The great herring fishery. Newfoundland cod fishery. The salmon of British Columbia. Anchovy, tunny, and sardine. Sturgeon. Oysters, lobsters, crabs. Whale and seal fisheries. Sponges. Coral. Pearls.

Birds.—Useful food all over the world. The domestic fowls. Feathers, *e.g.* eider down and ostrich plumes.

Discuss man from an omnicarnivorous point of view, showing that there is scarcely anything, however repul-

sive, that is not eaten in some part of the world, *e.g.* horse-flesh in France and other Continental countries; dogs in China; alligator in Central America; frogs, leeches, snakes, etc.

Materials for Manufactures.

Wool, Hair, Hides, Bones, Hoofs, etc.—Describe the great trade in wool. Chief wool markets. Merino sheep. Alpaca. Vicuna. Cashmere goat. Fur-bearing animals. Hunting and trapping. Rabbit plague in Australia and its atonement in export trade in rabbit skins. Ivory.

Silk.—The habitat and food of the silkworm. The raw silk exporters. The silk manufacturers.

The foregoing by no means exhaust the flora and fauna of the world, but it at least includes all of commercial importance.

COMMON-SENSE NEEDLEWORK.

BY MISS FLEMING,

Authoress of "How to Teach Needlework," "Pupil-Teachers' Needlework," "Sewing-class Guides," etc.

FLANNEL JOINS.

ALL joins in flannel are made by means of running stitches, which should be small, regular, firm, and taken clean through both thicknesses.

A backstitch put between every three or four stitches renders the seam stronger.

The fixing stitches are placed about ¼-inch from the raw edge of the flannel.

The running stitches come just below the tacking threads.

Lengths of flannel are tacked together in two ways:—

1. With both edges lying evenly side by side. After the running is completed, these edges are opened out, and a row of herring-bone stitches worked either through the middle, or over the raw edges on each side. The former adds to the strength of the join, but the edges do not look as neat as they do by the latter method.

2. They are tacked together and run neatly with the back strip standing a little above the front strip.

The back is then tacked down over, and enclosing, the front edge. Care is required that no fold is left in the seam on the right side. This is herring-boned, when it forms a neat, firm join. All the herring-bone stitches must show clearly on the right side.

The excellency of herring-bone depends upon the regularity of size in the stitches. As so much thread is visible it should never be very thick.

CUTTING OUT SQUARES AND OBLONGS.

The cutting out of squares and oblongs may be made a means of training both "hand and eye."

Different kinds of scissors should be shown to the class, and their uses elicited. The teacher's own large cutting-out scissors, buttonhole scissors, and those the children use will be sufficient for illustration purposes. Large scissors are called "shears."

Draw from the class all they can find out for themselves by looking at the articles in question. They are composed of two "shanks" as they are called. These are joined together by a screw. Each shank has a hole at one end for holding the thumb and one or two fingers, and a point on the other. Sometimes one hole is larger than the other, as in teachers' cutting-out scissors. The lower half of the shank is sharp at one edge and blunt at the other. The sharp edges face each other. One point is blunt and the other sharp. The sharp point is always turned towards the floor when cutting, and the blunt point on the top. The shanks of the teacher's scissors will prove that, as the larger hole is to hold two or three fingers and the smaller one will contain the thumb only.

Now show how to cut a stiff piece of paper by placing it as near the screw as it will go, and cutting as much as possible, with one movement, without actually closing the points. The points, or tips, are only made to meet when the edge is reached, or when snipping small pieces. To produce a clean, straight cut, without jagged, uneven edges, a long incision is made without allowing the points to meet.

Writing-books that are completed provide ample and suitable cutting material at this stage, as the aim at present is to get sweeping cuts with regular, even movements.

While the girls should be encouraged to make the strips fairly straight, it would not be well just now to insist upon exact lines. In the next lesson, the same kind of paper might again be used, but now the aim is to cut straight along given lines. Strips the length of the paper, but differing in width, say, from two to four spaces, could be produced. A few judicious questions will test what ideas the girls have of measurement. The length and width of the paper in inches might be elicited. When several strips have been cut with clean edges, the class could be shown how to form them into squares and oblongs by one movement of the scissors. The girls may be told to cut lengths of so many inches, and then allowed to test their measurements with rulers. These devices train the eye and exercise the judgment.

In the drawing lesson, squares, oblongs, and other rectangular figures could be drawn, either by freehand or ruler on plain paper, and these could be cut out next lesson—wherever practicable only one movement of the scissors being made.

When sufficient practice has been given with stiff paper, newspaper or thin lined cutting-out paper may be substituted. The class should be shown how to rest the scissors on the desk, and to continue cutting a long line with the regular, sweeping movement to which reference has already been made. These strips will be found useful for the fixing of hems, seams, and fells, during the needlework lesson.

Long narrow strips may represent bands for the tops of chemises, broader ones for tops of drawers, and shorter ones for bottoms of knickers and nightdress sleeves. The girls should be taught to measure each other for all these things, and to estimate the size, using their rulers to prove the correctness of their judgment. These bands can be fixed—long sides first and short ones last—all having a narrow turning. It would also furnish excellent practice if they were doubled down ready for setting on, and the ends tacked ready for sewing up—indeed there is no reason why the actual stitches should not be put into the paper. In this way, the girls see that they are doing something of real value, and the lesson will become all the more interesting on that account. If there be some standard of measurement in the room, such as

a dual desk (which is usually about a yard long), the class may be asked to produce bands a given length and width. It will be found that some children have a splendid idea of length and others very little—the testing will to some extent rectify defects of judgment.

Darning on Canvas.

Preparation.—A. L. Sewing Illustrator having darn worked with slanting edges. A woollen garment darned, and another with a thin place needing to be darned. Specimen darns, sufficient in number for one to be placed between two girls, squares of cheese-cloth or single-thread canvas, rug needles, and darning-wool.

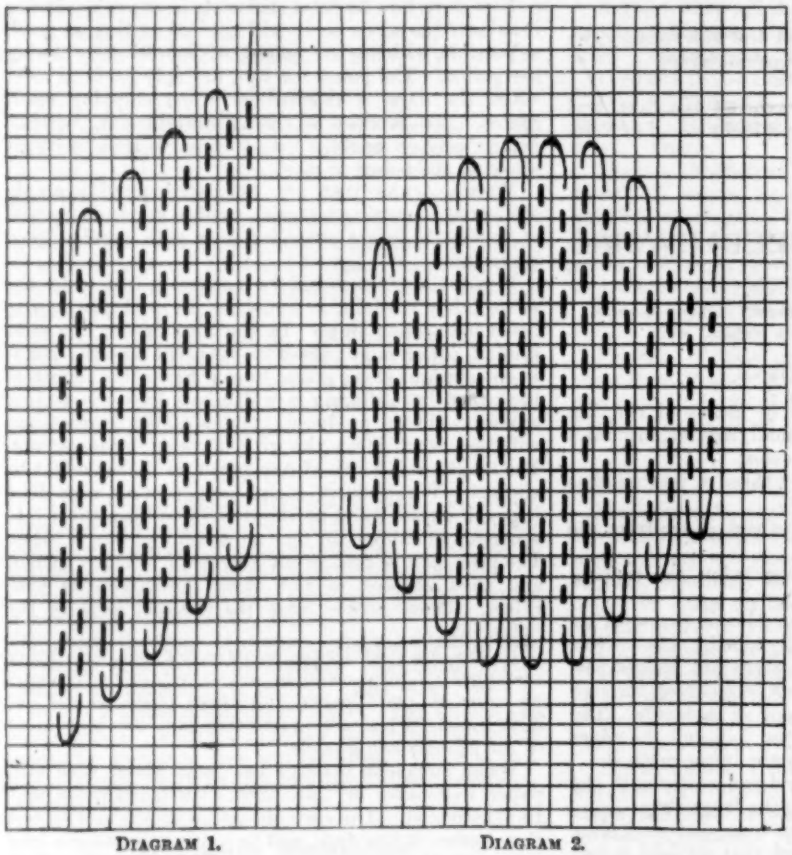


Diagram 1. Diagram 2.

Conversation.—Draw attention to the length of the darners and the size of the eye as compared with a sewing-needle, and give reasons. Get the girls to name various articles that are darned. Encourage them to suggest the reason canvas is used for teaching purposes. Educe, from the specimens they have, and the Illustrator, that the working lines go up and down, and that they go under one thread and over another.

Exhibit a woollen darned garment, and one with a thin place that needs darning. Elicit that it would be easier to darn before a hole is made, besides looking less clumsy than a patch.

Information and Suggestion.—Darning on canvas is only a preliminary to darning on any plain material, as the threads can be counted more easily and the rules learned more quickly.

Let the girls examine their specimen exercises. They will find out for themselves that the lines go up and down, that top and bottom are not straight, and that loops are left at the end of each line.

The reasons should be given.

Darns always run along the threads of the material, as they are intended either to strengthen them or replace them altogether.

The top and bottom of a darn are irregular, so that the "pull" is not all borne by one set of threads, which would probably cause a break. That can be demonstrated on the Illustrator by making a straight-edge darn and pulling it tightly. The strain caused represents what happens in the wearing of an article.

The use of loops can be shown in the same manner.

A further reason for loops lies in the fact that the garment, having been washed many times, has shrunk considerably, while the mending-wool has yet to undergo the same process.

Demonstration by Teacher.—Commence a darn on Sewing Illustrator. Point the needle upwards and take up one thread and leave one, until there are ten or twelve on it. Draw the needle out, leaving an end about half an inch long. Put the needle in for the second row, one thread higher up, leaving one thread between the two rows, and pointing the needle downwards. Take one and miss one to the end, drawing the needle out one thread above the first stitch, leaving a loop at the top of the line.

The class must be told to observe that the threads missed in the first line are taken up in the second, and *vice versâ*, and that the needle is pointed alternately up and down.

Continue working for a few rows, and draw the attention of the class to the top and bottom of the darn, which slopes upwards in both cases.

Demonstration by Sample Girls.—Let a girl come out and work a few rows on the Illustrator. Others may do the same if thought necessary.

Now show how to hold the work over the first and second fingers of the left hand, keeping it in place with the thumb and third finger. Let the class do the same.

Show also how the needle is pointed away from the chest in one row and towards it in the other, the class repeating the movement at command.

Inspection of Method.—There will be no necessity to go in and out of the desks. It will not be difficult to detect, from the front of the class, those who are not handling their work properly.

In subsequent lessons practice will be ensured, and variety produced, by making darns of different shapes, having Diagrams 1 and 2 as their foundation.

Darn for a Thin Place.

Preparation.—A. L. Darning Illustrator with an octagonal-shaped darn worked. Underneath indicate a "thin place" by coloured chalk or coloured tacking thread.

Squares of stocking-web, darning-needles, and wool.

Conversation.—Elicit characteristics of stocking-web material, its elasticity, the loops, etc. Revise what has previously been taught in the "darning on canvas" lesson.

Information.—It is advisable to prevent a hole, but it is not always possible, for a pull or friction may cause a defective thread to give way, which quickly forms a hole.

Most woven materials shrink when washed; but, by the time the garment requires darning, all shrinking will probably be over. The worsted or wool used for darning has yet to undergo the shrinking process. As the loops formed by knitting are joined in unbroken continuity, a very elastic fabric is produced. For these reasons, loops are left at the end of each row, to allow for shrinkage without injury to the mended garment. It is immaterial whether the loops are afterwards cut or not.

It is not desirable that the upper and lower edges of the darn should be straight, because the old web is more or less rotten, and if the new wool with its weight and strength bears entirely on one thread of the old material, it will probably tear out and make the hole larger. This danger may be avoided by giving the darn any shape but a square or an oblong.

They may be shaped as the diagrams in "Darning on Canvas."

A darn either strengthens a thin place or fills in a hole when the material has worn away.

It is worked on the wrong side of the material.

Draw attention to the fact that each row is composed of loops that curve upward, and others that curve downward.

The method of work has already been taught on canvas.

Demonstration by the Teacher.—Pointing the needle from the chest, pick up the loops that curve upwards, missing one and taking the other, till four or five loops are on the needle.

Draw the cotton through, leaving about half an inch loose at the end.

Turn the needle towards the chest and put it into the next loop on the line above the last stitch.

This time, the loops curving downwards are picked up, keeping to the alternate rows that were passed over last time.

Continue working until you get one stitch below the last line, which will produce two more stitches on the needle than were in the preceding row.

Each row will increase in length by two stitches, until the darn is as big as is required.

The decreasing may commence at once, or two or three rows of equal length may be worked in the middle, after which, the lines decrease by two stitches until the last row is the same length as the first one.

Demonstrate the difference between a straight-edged darn and an irregular one.

When pulled or dragged, the effect is apparent to the class. If loops are not left, much the same effect is produced. The loops should be neat and regular. They may be cut after the darn is finished, if preferred; when the article is washed, the ends will lose themselves in the tissue.

Demonstration by Sample Girls.—Let several girls work a line or two on the Illustrator.

The class may now commence work.

Darning is the most economical way of mending flannel raiment and garments made of woven materials, as well as table linen, and should be used in preference to patching for those things.

When garments have been well worn, a sharp watch should be kept, that they may be darned before a thin thread breaks into a hole.

Black silk washes better than black cotton, which does not keep its colour. For that reason black stockings, and any black material that requires washing, are more sightly if worked with silk. With that exception the darning cotton or wool should be the same colour and texture as that of the garment which it is to replace.

The following rules are of universal application in darning:—

(1) Darn a thin place before it breaks into a hole.
(2) A thin place will not need crossing. A hole will.
(3) Do not make the top and bottom of a darn straight, because the strain would all have to be borne by one set of threads.
(4) Leave loops at the end of every line.
(5) Begin at the left hand and proceed to the right.
(6) The mending thread, or cotton, should match the material to be mended in texture and colour.
(7) On stockings, begin to darn on the lines of knitting that form a rib: on calico, the lines that are broken.
(8) Take up one stitch and miss one. In the first row the needle will pick up the loops curved upwards, in the next those curved down.
(9) Keep the darn quite flat. A piece of cardboard tacked under the hole secures that.

Repairing Table Linen.

The signs of wear in table-cloths and serviettes must be looked for along the folds, for after table napery has been subjected to constant washing and ironing for a few years it becomes thin in those places. It is then a good plan to fold the article into three, instead of four parts, when ironing, so as to distribute the wearing strain. In this department, as in all that relates to needlework, "prevention is better than cure," and when any article is showing signs of wear (this may easily be detected by holding it up to the light), a few lines of darning will often defer the coming hole.

Some people use the linen make of threads for mending table-linen, but, as the thread passes backwards and forwards through the fabric, the friction rubs it, when it becomes thin and often breaks. Others find the soft darning or embroidery cottons more suited to the work, as they do not fray so easily. In any case it should be finer than the original material.

When neatly darned on the wrong side, the repair scarcely shows on the right side.

A hole that is too large to be replaced by a darn will need patching. Though patches, as a rule, are not advisable in a table-cloth, they are better than holes, and they can often be covered by the tea tray, a table centre, or a flower stand.

When the signs of wear are becoming apparent, it will be well to give heed to the edges of the cloth,

which will probably begin to crack, and either strengthen them by making a hem on the selvedge side, or cut a strip off and make a fresh hem on the already hemmed side. The selvedge may also be strengthened by a strip of tape felled on the wrong side of the weak part.

Should a darn be also necessary, the tape will strengthen it still further. Sometimes it is better to cut a strip off the selvedge before hemming it up. This will change the position of the centre fold, and will add to the life of the cloth.

Occasionally a longitudinal or warp darn will be sufficient, without any crossing.

Darns will be more easily worked, if the hole be tacked firmly over a piece of cardboard, or American cloth, or oil-cloth, the wrong side being uppermost.

There is an art of making invisible darns used in cloth-drawing, and there are also fancy darns, beginning with twill darns and going to more elaborate patterns representing the various methods of damask weaving, but these are too advanced for girls in elementary schools.

Any girl who is quick with her needle, and anxious to pursue the matter further, will be able to work out patterns for herself, as in all cases the warp or longitudinal darning is done first in the ordinary fashion. Then, to form a darn of twill pattern, one thread is taken up and three left right across the hole. In the second, and each succeeding row, a thread is advanced in the same direction so as to follow diagonals across the darns. Other patterns are only variations of the same method.

TEACHING NOTES ON "THE HISTORY OF LONDON."

By the Author of "Practical School Method Notes," etc.

C.—LONDON UNDER THE TUDORS AND STUARTS.

I. How London was Governed.

Before proceeding to give an outline of London during the Tudor and Stuart periods, it will be as well to have some idea as to the manner in which London was governed, and the growth of the municipality.

1. London secured various privileges from the sovereigns. As the demands, *i.e.* taxes, increased the people obtained greater privileges, and were prepared at any time to maintain their rights and defend their liberties.

2. After Alfred had resettled the city it was divided into various wards or manors.

3. "There was no corporate government of the city" at this time.

4. The chief, or king's, officer was the *portreeve*, who acted as the treasurer and guardian of customs and dues. The Bishop of London, too, took a large share in the government of the city.

5. There were two motes—the folk-mote and the ward-mote.

6. The merchant guilds and craft guilds controlled all affairs connected with the various trades.

7. There was also a military organisation—the *knighten guild*—established for the purposes of defence. One of the duties of this organisation was to see that the citizens were properly and adequately armed.

8. The first city corporation was formed in the reign of Richard I., the first mayor being Henry Fitz-Aylwin. Many changes were now brought about—the portreeve disappeared, the power of the sheriffs was curtailed, and the folk-mote had merely a nominal existence. The merchant guilds and craft guilds ceased to exercise any control over trade. The city gradually became "one incorporation under one government."

[*Note:* The numbers as given here represent the various stages in the growth of the municipality.]

II. Destruction of the Monasteries.

During the reign of Henry VIII. most of the monastic houses were destroyed—an act which caused widespread misery, and increased the number of vagrants and paupers. It is interesting to note that the monastery of St. Bartholomew, in Smithfield, was converted into the Hospital of St. Bartholomew; Christ's Hospital was established on the site of the Grey Friars' monastery; and the Charterhouse took the place of the monastery of the Carthusians.

III. Improvements and Progress (1540–1699).

1. Moorfields, an open and impassable swamp, was drained in 1540, and bridges were erected over the ditches.

2. In the reign of Henry VIII. London streets were paved for the first time.

3. During the reign of Elizabeth, proclamations forbidding the erection of additional houses in, or near, London were issued with the idea of checking the too rapid growth of the city. Very little attention, however, was paid to these, and thus suburbs sprang up outside the city walls.

4. In the year 1620 London received for the first time a plentiful supply of water by the New River Company, the supply being brought from the New River, which runs from Chadwell, near Ware, in Hertfordshire.

5. Through the Revocation of the Edict of Nantes (1685) the Huguenots, or French Protestants, fled from their country; many found a home in London and settled there, thus giving rise to various industries, the most important being silk-weaving.

6. *St. Paul's Cathedral* was opened in 1697.

7. *Billingsgate Market*, for the sale of fish, was opened in 1699.

IV. A Trio of Disasters.

PLAGUE, FIRE, AND HURRICANE.

1. **The Plague.**—The streets at this time were narrow, badly drained, and filthy. A plague broke out in the year 1603, when 30,000 persons died. Sixty-two years later, in 1665, occurred the *Great Plague of London*. "The Plague was the twelfth of its kind which visited the City during a period of seven hundred years" (Besant).

The deaths during the four weeks of July are given as 725, 1089, 1843, 2010. During August and September the number of deaths rose alarmingly. The following entry for September is taken from Pepys' *Diary:* "To the Tower, and there sent for the weekly Bill, and find 8252 dead in all, and of these 6978 of the plague, which is a most dreadful number, and shows

reason to fear that the plague hath got that hold that it will yet continue with us." A hundred thousand are reported to have died from the Plague.

[For details of the Plague consult Defoe's *Journal of the Plague Year*.]

2. **The Great Fire.**—In the following year (1666) London was visited by a great fire, which began on September 2 in a baker's house in Pudding Lane, near Fish Street Hill, London Bridge. The houses, being made of wood, rapidly caught alight one after the other, and to add to the horror a strong wind was blowing at the same time. Five-sixths of the city was consumed, 13,200 houses were destroyed, together with 89 parish churches, four of the City gates, St. Paul's Cathedral, the Royal Exchange, and other buildings.

This fire was no doubt a blessing in disguise, for no less than 436 acres were swept by it, and the narrow streets and badly constructed houses disappeared for a time. Stone-built houses were now erected and the streets were made wider, but full opportunity was not taken during the rebuilding, many of the streets being still narrow and tortuous.

The *Monument*, at the bottom of Fish Street Hill, was designed in commemoration of the Great Fire of London by Christopher Wren, the architect of St. Paul's Cathedral. It is 202 feet in height, and is situated 202 feet from the place where the fire began. An inscription near Smithfield marks the place where it ceased.

[The descriptive account of the Great Fire given in John Evelyn's *Diary* is well worth reading.]

3. **A Hurricane.**—In 1703, a year after the accession of Queen Anne, a severe hurricane visited London. Seven hundred people lost their lives, many ships were sunk, others were dashed against London Bridge and smashed to pieces, and houses were destroyed. In all, the damage done was estimated at £2,000,000.

V. Two Important Buildings.

1. **The Royal Exchange.**—The rapid growth of the trade of London during the Tudor era was due to Sir Thomas Gresham more than to any other man. It was he who originated the idea of a Royal Exchange similar to what he had seen at Antwerp when he was acting as Royal Agent. On January 23, 1571, the building was opened in person by Queen Elizabeth, who named it the Royal Exchange. Gresham's building was destroyed by the Great Fire of 1666. It is curious to note that the statue of Sir Thomas Gresham was the only one not destroyed by the fire. "Though fall'n from its nich in the Royal Exchange it remained intire when all those of the Kings since the Conquest were broken to pieces" (John Evelyn, *Diary*).

2. **The Bank of England.**—The Bank of England, which was established in 1694, owed its origin to William Paterson, a Scotsman. To meet the demands of the growing commerce of London an establishment of this kind was necessary in order that financial operations might be carried on. The stability of the Bank of England, which Adam Smith declared was equal to that of the British Government, has been one of the chief factors in securing Great Britain's commercial supremacy. At first, the Bank carried on its operations at Grocers' Hall, Poultry. The building known as the Bank of England, and situated in Threadneedle Street, was not begun until 1734.

VI. Stuart London.

The chief characteristics of London during the Stuart period were as follows:—

1. The roads were paved with cobble stones, the streets were narrow, many of the houses were made of wood, and the upper stories projected over the shops. Houses were known by signs instead of numbers, *e.g.* "Golden Fleece," "Saracen Head," &c. "The street signs, which were necessary, as houses were not numbered, were very numerous and large, and some were exceedingly costly" (Ashton).

2. "There was no foot-pavement in London as distinguished from the carriage-road. The carmen in the principal road fought with the hackney-coach drivers. The chairmen drove the foot-passengers off the railed-in way; and the foot-passengers themselves struggled for the honour of the wall. Every square and open place was a receptacle for rubbish and filth" (Knight).

3. "The streets were ill-lighted or hardly lighted at all."

4. "The Lord Mayor of London was never seen in public without his rich robe, his hood of black velvet, his gold chain, his jewel, and a great attendance of harbingers and guards" (Macaulay).

5. In the reign of Queen Anne the coffee-house, that great social institution, reached the zenith of its popularity. "It was the centre of news, the lounge of the idler, the rendezvous for appointments, the mart of business men" (Ashton).

6. Much time was devoted to sport, sight-seeing, and various other amusements. Among the rougher sports were bear-baiting, bull-baiting, and cock-fighting.

7. There were four theatres in Queen Anne's time, but, as a rule, only two were open at the same time.

8. Capital punishment was frequent in those days. During the period 1701–1713, 242 malefactors were hanged in London alone. Hanging was the chief form of punishment. Pressing to death was also common. The pillory was made good use of. Debtors were imprisoned.

9. "The senseless custom of duelling was much in vogue in this reign" (*i.e.* Queen Anne), "although perhaps it had not reached the height it afterwards did. The custom of wearing swords rendered the arbitrament of every dispute liable to be settled by those weapons. A few hasty words and the sword was whipped out, and probably one or other of the combatants had reason to regret his loss of temper" (Ashton, *Social Life in the Reign of Queen Anne*).

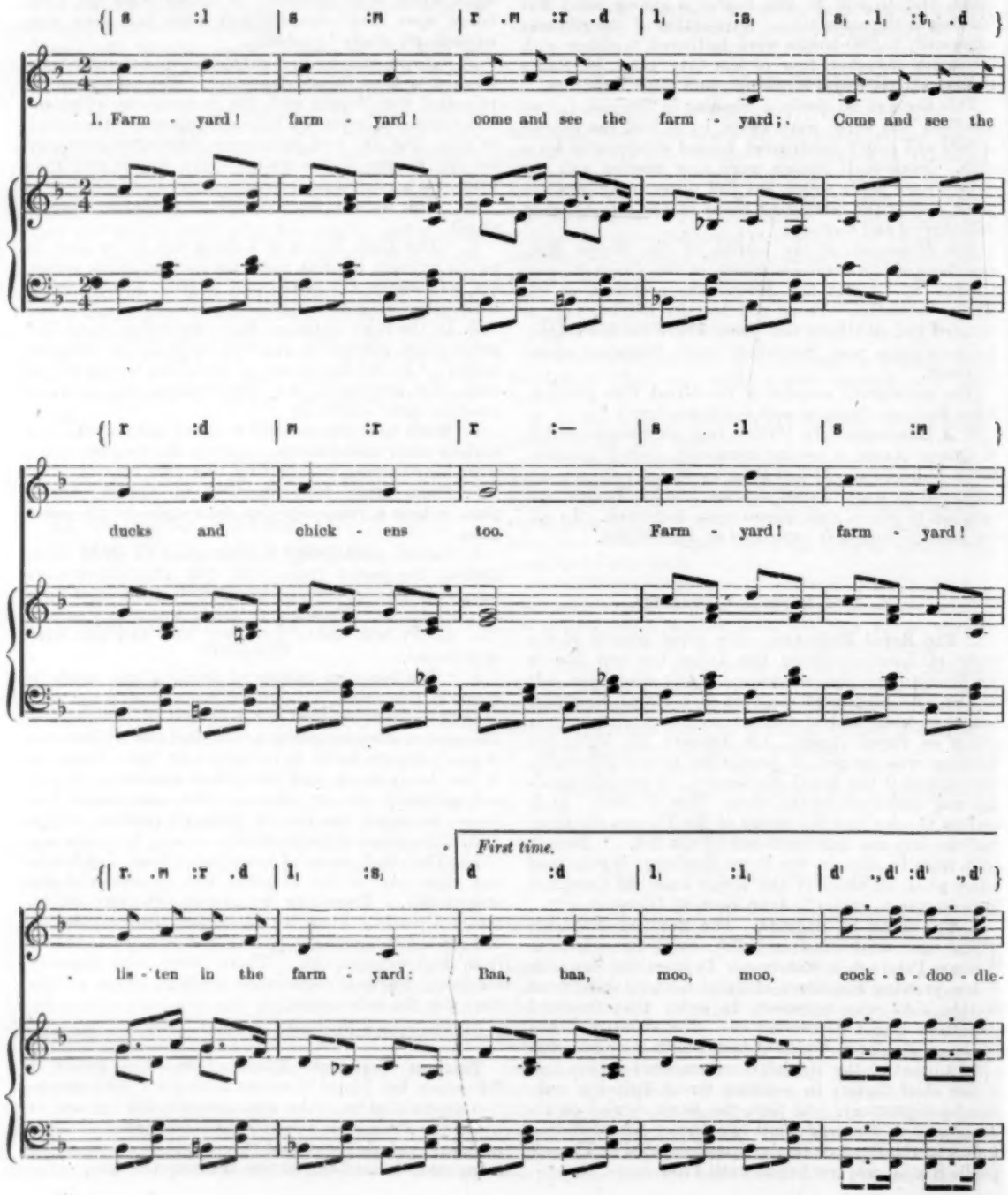
10. The chief mode of conveyance from London to any other part of the kingdom was by means of the stage-coach. Travelling by stage-coach was by no means a pastime when we remember the condition of the roads, the continual jolting, the liability to attack from highwaymen, &c. There were also hackney coaches. Another conveyance much in vogue at this time was the sedan-chair.

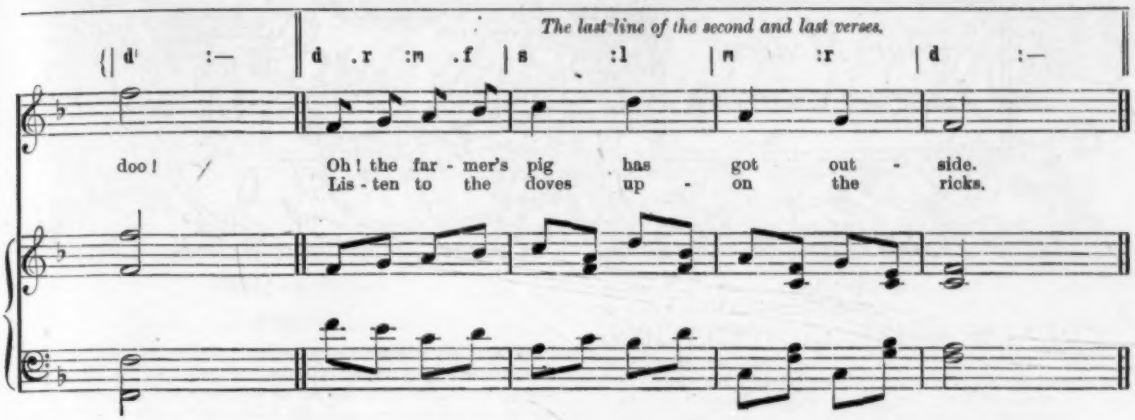
Teachers' Certificate Examination.—The Board of Education has issued circulars asking the local education authorities to make arrangements for centres at which the Preliminary Certificate Examination shall be held, and pointing out that it may not be necessary in many cases to hold this at the Training Colleges.

THE FARMYARD.

MASS GAME.

Words and Melody by SISSIE TURLEY BUTLER. *Arranged for the Piano by* LILLIE TURLEY.

KEY F. Doh is F.

{| s :l | s :m | r .m :r .d | l, :s, | s, .l, :t, .d }
1. Farm - yard! farm - yard! come and see the farm - yard; Come and see the
{| r :d | m :r | r :— | s :l | s :m }
ducks and chick - ens too. Farm - yard! farm - yard!
{| r. .m :r .d | l, :s, | First time. d :d | l, :l, | d' .,d' :d' .,d' }
lis - ten in the farm - yard: Baa, baa, moo, moo, cock - a - doo - dle-


The last line of the second and last verses.
d' :— | d .r :m .f | s :l | m :r | d :—
doo!
Oh! the far - mer's pig has got out - side.
Lis - ten to the doves up - on the ricks.

Instructions for Game.—Children form a ring to represent the wall of a farmyard. The yard has many gates—one between each child. To open gates, the joined hands are raised and children stand apart; to close, the hands are lowered and the children stand close together. The animals stand inside; only use about six, so that they will easily know their names. Farmer walks round inside. Children move round in a circle rather close together, with hands joined.

All sing. 1. Farmyard! farmyard! come and see the farmyard;
Come and see the ducks and chickens too.
Farmyard! farmyard! listen in the farmyard:
Baa, baa, moo, moo, cock-a-doodle-doo!

The animals chosen give their cry together—"Baa, baa," "Bow-wow," &c.

All sing. 2. Farmyard! farmyard! come and see the farmyard;
Come and see, the gates are open wide.
Farmyard! farmyard! listen in the farmyard:
Oh! the farmer's pig has got outside.

The pig runs for his life round the outside of ring, chased by the farmer, and when caught is brought back. The cow next tries to escape; if two children close together before she can pass, she must try another gate quickly. Farmer gives chase directly they escape. Sometimes all six might try to get out together. When all are safely in—

All sing. 3. Farmyard! farmyard! come and see the farmyard;
Come and see the way we feed the chicks.
Farmyard! farmyard! listen in the farmyard:
Listen to the doves upon the ricks.

All say quietly—"Coo-oo, coo-oo."

If time, repeat from the beginning.

Our Modern Language Section

FRENCH PRIZE COMPETITION.

RULES.

1. All translations should be **posted not later than September 8th, 1906**, and addressed:—PRIZE EDITOR, Office of the *Practical Teacher*, 35 and 36 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.
3. Competitors should write pseudonym only on MS. Prize-winner will be asked to send name and address for publication.
4. No competitor may take the prize offered more than once in three months.

A Prize of Half a Guinea is offered for the best rendering into English of the following extract:—

"La perfide Albion" est une invention des pamphlétaires qu'entretenait loyalement Napoléon pour salir la dynastie et le parlement britanniques. Le mot fit fortune. Il couvrit toutes les déconvenues de l'impéritie ou de l'imprévoyance de nos gouvernements dans leurs rapports avec l'Angleterre. Un des clichés les plus vénérables de notre journalisme nous représente à divers moments historiques "tirant les marrons du feu" pour une alliée avide et sans foi, alors qu'il y aurait eu plus justement sujet d'accuser notre propre inaptitude à discerner, dans une situation donnée, les avantages réels qui nous avaient échappé. En Crimée, en Egypte, par exemple. Nous nous consolons en accablant un complice plus avisé et en nous reconnaissant une honnêteté sup rieure quoique tardive. On pense au mot de Laclos cité dans les pages qui suivent: "Voilà bien les hommes, tous également scélérats dans leurs entreprises, et ce qu'ils apportent de faiblesse dans l'exécution, ils l'appellent probité." Sans prétendre conférer à l'Angleterre un monopole auquel elle ne prétend pas elle-même, on peut affirmer que le goût et le culte du *Fair play* (sorte de chevalerie bourgeoise), et de la véracité, caractéristique si accentuée de l'éducation et des mœurs anglaises modernes, a gagné les mœurs politiques.

From "L'Ile et l'Empire de Grande-Bretagne," by ROBERT D'HUMIÈRES.

RESULT OF THE JULY COMPETITION.

The prize is awarded to "T. V. D." (Will "T. V. D." kindly forward name and address for publication?)

First Class.—Phil, Murillo, Babs, Dim, Sorbonne, Lytton, Tokio, Alter ego, Haud dúbitans, Max, Polyglot, Débutante, Agaznog, Winnowsty, Marque, Stonefield, Carpe diem, Nehemiah, Dindon, May.

Second Class.—Bride, Margaret, Malta, Cærfryddin, Alpha, Stradivarius, Dorine, Frosine, Saxonne, Beauty, M. A. G.

The name and address of "Quis," the winner of last month's competition, are:—Miss M. Duckitt, Waylands, 159 East Dulwich Grove, London, S.E.

Report.

It is a very great disappointment to find a heavy drop in the number of competitors this month. It is the more disappointing as the number of entrants has this year kept up so satisfactorily, and we have had such encouraging tributes from competitors as to the interesting nature of the extracts set and the general value of the competition itself. It may be that the brilliant weather we have been enjoying has indisposed competitors to undertake the extra exertion necessary, or it may be there prevailed an exaggerated idea of the difficulty of the piece set. We always endeavour to set pieces of a good literary character, and which, when not narrative, shall be worth study from the thought which runs through them. We trust next month this temporary drop will be made up for.

The general merit of the pieces was decidedly low. Even the successful competitor did not grasp the meaning of *pour gagner quelques rangs*. It means "to get a few rows nearer," *i.e.* nearer to the stage. *Elle grimacerait demain* means "To-morrow she would be looked on as affected." When middle age tries to pass itself off as youth, affectation is the natural result. Generally speaking we have to repeat an old criticism. Too many competitors do not grasp the central idea of the piece, and bring the whole of their version into harmony with it.

Prize Translation.

We should always remain in our prime, and be able to arrange our life as if we were still twenty-five years old, for that is the time when we most naturally behave in a manner we think will most conduce to our welfare, and when we acquire our fixed habits. But the white hairs have for many years fallen like snow over our hopes, and, after all, would it not seem chilling and pitiable! At one time a woman may have shown signs of ambition, without however being covetous, but there were also signs of love, for she had in view the renown and precious happiness of her beloved one. Her enthusiasm was charming, for she was young. But now she is young no more, or not so young as she was then, and is she therefore to be accused of slothfulness because in certain moments she prefers inaction? Is it not rather that she is restrained by a conscious fear lest her movements should be awkward and that to-morrow she should be giving herself airs? Is it not that she anticipates a kind of contradiction, a gap, between approaching middle-age and the ideals of her youth, once so eager and charming? That same energy which is wisdom and foresight in the young will become childish if indefinitely prolonged. An ambitious old age would be an absurdity, for what is the use of troubling to gain a few more distinctions when the comedy is nearly played out? We are cowardly and weary enough to desire repose for ourselves and our own, because we have passed the vivacious age. The knight must embark on every crusade at the bidding of his dame-errant, for she believes that her future is an eternity.

T. V. D.

OUR TUTORIAL SECTION

NEW SCHOLARSHIP COURSE FOR 1906-7.

BY ARTHUR T. FLUX,

Late Principal of the Belvedere Pupil Teacher Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.

Work for the Month.

PART I.

1. *Reading.*—Regular practice must be taken daily, with a high ideal. "If," said Ruskin, "I could have a son or daughter possessed of but one accomplishment in life, it should be that of good reading." The voice must be clear and pleasant, the natural and not an assumed voice, the vowels pure and full, the consonants precise and distinct. The majority of people talk naturally and intelligibly, the greater number of young readers do not. Dr. Dunstan, in his clever little book on voice production, gives some good exercises. Read the following, or, if possible, get some friend to write from your dictation—the result will show whether you are enunciating correctly: "Keep lace, keep place; distinct races, distinct traces; shrewd aim, shrewd dame; take air, take care; grief alters, grief falters; native ales, native vales; harmonious hounds, harmonious sounds; glorious ease, glorious seas; warm thaws, warmth thaws; stirring all, stirring call; broken ease, broken knees; bare ode, bare road; a very ell, a very yell."

2. *Recitation.*—Learn the next twenty lines, and remember that verbal accuracy is not enough.

3. *Penmanship.*—Write a page daily in the *Practical Teacher Copy Book*, and use great care at all times. This is a subject which *must* receive attention.

4. *Composition.*—The essays sent in for correction still exhibit serious faults, faults which can be eradicated quickly if the effort is made. There must be continual practice and adequate criticism. There is no candidate taking the examination whose English is not capable of improvement, but improvement is impossible unless defects are pointed out, and hence the offer made to criticise and return any essay sent in. Some of my readers are apparently tired of being advised to read widely, but as this is the certain basis of all good writing, the advice must be continued even *ad nauseam*.

The student will find in any good text-book examples of incorrect diction or slipshod sentences, which should be studied and the correct expression determined. There is an excellent collection in Nesfield's *Grammar and Composition*.

E.g. "It is wrong *to aggravate* your parents." *Aggravate* means to "heap up, to increase," and would be correct in such a sentence as—The prisoner's conduct aggravated his offence.

"His hair was parted in the *centre*," should be in the *middle*. A centre is a point.

"*Innate* depravity, due to early training and general recklessness of life." *Innate* means "born in one." Depravity due to training is not innate.

Words are often thus used in an incorrect sense. "He was a *novitiate* in the monastery," for *novice*.

"A *verbal* agreement is less binding than a written one." *Verbal* should be *oral*.

A knowledge of the etymology of words is practically essential to their correct use; without this, ill-educated persons make ludicrous mistakes, as did the lady recently who, describing an accident on the cliff, stated that she was "nearly participated over the prejudice."

I have had some inquiries about the sentences given last month.

"The flowers smell sweetly," should be "sweet." "To regularly see you" is an example of the split infinitive. "Partaking of a breakfast," means sharing it with some one. "The enemy's capture" is ambiguous; it might be "the capture of the enemy," or "the capture by the enemy." "Would have liked to have seen," should be "would have liked to see."

I shall be pleased to give a book prize to any candidate who sends in the best correction of the following, with reasons for any alterations made:—

(1) A wicked and unveracious story is related of him.
(2) He breathed his last in indigent circumstances.
(3) A quite unique compliment was paid to the navy.
(4) Driving down the street his horse ran away.
(5) He did more for his country than any man living in his time.
(6) A magistrate can see whether a prisoner is lying better than the jury.
(7) His success is neither the result of system nor strategy.
(8) Young Gregson had promised his father to visit his friends.
(9) There were very few passengers who escaped without serious injury.
(10) I never have and never shall accept his invitation.

Write one or two essays each week on such subjects as the following:—

(*a*) We live in deeds not years, in thoughts not breaths,
In feelings, not in figures on a dial.
(*b*) The outlook in Russia.
(*c*) The simple life.
(*d*) Shakespeare's *As You Like It*.
(*e*) Villenage.
(*f*) The value of knowledge.
(*g*) As civilisation advances poetry declines.
(*h*) Write in prose the subject of any poem you have read.

Read up the subject if necessary, make a rough analysis of what you wish to say, arranging the ideas under heads, and let each paragraph deal with one phase of the subject. The following notes may be of assistance:—

(*a*) The quotation is only another way of stating the great principle that work is the first duty of every man. A long life spent in selfish laziness, in gratifying every desire, in carelessness as to those around, is a very low ideal. It is the duty of every man and woman to take part in the world's work, and to help on, in however humble a manner, the improvement—mental, moral, and physical—of the whole of the world's population. The opportunities offered vary with the varying position of the individual; some men can do much, some from the exigencies of their position can do but little, but every one can do something. If a lifetime cannot be devoted to good work a few moments can, and a kind word or pleasant smile may do as much as a large cheque.

(*b*) This is a subject which is attracting the attention of the whole civilised world. We are watching one of those great movements which are inevitable in the life of any nation. From the remotest times the necessity for a leader was apparent to any tribe. He was their king or chief because he was the most able man to lead them in war or to rule them in peace. The Feudal System, which has obtained more or less all over the world, divided society into two classes—the governors and the governed—the former enjoying all the privileges and pleasures, the latter by the sweat of their brows supplying the means. But as civilisation advances and knowledge increases, there comes a time when the labourer demands a voice in the government, and declares his right to improve his position. Then a struggle ensues which ends, as it must end, in the admission of all men to a voice in the nation's government. Whether the struggle is a peaceful one or not depends upon race and circumstance. In England the revolt of the peasant commenced the struggle which was terminated only by the Bill of Rights. In France, the Jacquerie was suppressed by force and the peasants were kept in their degraded position till the Revolution, which being violent was bloody. In Russia exactly the same course is

being followed. The autocratic rule of an Emperor and his nobles was possible only so long as the people were ignorant. With the spread of knowledge has come the demand for constitutional government. The cry has increased in force, and a representative assembly, "The Duma," was called. The members proceeding to discuss points which were obnoxious to the nobility have been dismissed, and the cry for Reform is rising louder than ever. Exactly the same course of events occurred in France. The dismissal of the Tiers Etat instead of checking the movement gave it greater force, and the dismissal of the Duma is merely a step forward to constitutional rule. The Russian aristocracy is blind if it does not recognise this; the people can only be held down by the army and navy, and as the men constituting these forces are drawn from the peasant class, it is hardly likely that they will fight against their fathers and brothers. Reform must come; whether the result will be enormous bloodshed and a republic, or a peaceful solution and limited monarchy, depends upon the amount of opposition made by the aristocracy.

(*e*) There has been much discussion lately on this topic, and many people have advocated, in more or less forcible language, the advisability of giving up the artificial crowded life of the city and retiring to the peaceful simplicity of village life, in fact *cottagcitis* is quite a prevalent complaint. Those who urge it most strongly are probably those who have satiated themselves with the gaieties of a town and are suffering from ennui. To the dweller in a crowded city the pen-pictures of pretty cottages, pure air, green fields, rippling brooks, green meadows, or shady woods are very alluring. For a temporary change it may be well, but as a permanence few would enjoy it. The craving for wealth and luxury is not a peculiar feature of the twentieth century alone; it has been strenuously followed for the last sixty centuries, and it is equally true that now, as always, we saddle ourselves with worries which might be easily avoided. A simple mode of life might be adopted without retiring to the country, but few have the courage to do less than their friends and neighbours.

(*d*) There should be no difficulty with this subject after reading the play.

(*e*) This, again, should require little reading up. Show how villenage naturally followed the Norman Conquest; point out the miserable condition of the serfs and how obnoxious it was to the Anglo-Saxon spirit, and how ultimately it was abolished.

(*f*) All great writers have urged the value of knowledge, and one of the healthiest features of the human mind is its desire to know more. Any one who says "I know enough" is mentally unsound. Apart from the individual pleasure which accrues from a well-developed mind, there is a wider value, for all the comforts and conveniences of life come from the application of knowledge. The advantages can easily be traced by the student. There is one side of the question to be noted. Where knowledge is used for purposes of defrauding and oppressing others, it is clearly misapplied. Knowledge must be for the uplifting of all, and not for the selfish advance of the individual.

(*g*) This is true in some respects, not in others. In early days, before the art of writing was known, poetry was the only form of literature. The deeds of heroes were sung by bards, and these songs were preserved by word of mouth. Little was known of the outside world; science, as we understand it, did not exist, and consequently the bards could draw on their imagination and fill their poems with wonderful scenes and animals which had no existence. It is true that with the advance of civilisation and exact knowledge of the world, the whole creation of fauns and satyrs, werwolves, valkyries, imps and elves, fairies and hobgoblins gradually faded into nothingness; but, on the other hand, a new kind of poetry arose which would have been unintelligible in bygone days. If we cannot become excited over the crude efforts of some viking's skald, he would certainly go to sleep over, say, Pope's *Essay on Man* or Tennyson's *In Memoriam*.

5. *Arithmetic.*—The Metric System as applied to Length, Area, and Volume.

Little difficulty will be found with this, provided that the principles are thoroughly understood. The unit of length is the metre, an arbitrary unit supposed to the ten-millionth part of a meridian from the Equator to the North Pole. It is equivalent to 39·3708 English inches. The multiples of the units take the Greek prefixes Deca (10), Hecto (100), Kilo (1000); the submultiples the Latin *deci* ($\frac{1}{10}$), *centi* ($\frac{1}{100}$), *milli* $\frac{1}{1000}$. The unit of area is the square metre or *centiare*, or 100 square metres—the Are; that of volume, the cubic metre. Note particularly that the multiples of the metre proceed by 10's, of the square metre by 100's, of the cubic metre by 1000's. For capacity the cubic decimetre gives the litre. The relationship of the various tables must be clearly understood. If diagrams are drawn this becomes at once apparent. Work as many examples as possible, including the following:—

(1) (*a*) What is $\frac{3}{10}$ of 8 metres 74 centimetres?

(*b*) What fraction is 3 metres 15 centimetres of 13 metres 16 centimetres? Ans. 1·38 and $\frac{315}{1316}$.

(2) The rainfall on a certain day is 25 millimetres. What weight of rain will have fallen upon a rectangular district whose length is 5 kilometres and breadth 4·4 kilometres? (A cubic centimetre weighs 1 gramme.) Ans. 550,000,000 kilogrammes.

(3) How many cubic centimetres make a cubic metre?

Find to the nearest pound the value of 199 kilogrammes. (1 gramme = ·0022046 lbs.) Ans. 1439.

(4) A metre = 1·093 yards. Express to three places of decimals.

A square metre in square feet. Ans. { 10·751
A kilometre in miles. { ·621

What is the difference in yards between 13 miles and 20·62 kilometres? Ans. 342·34.

(5) Supposing a metre to be 40 inches, and 25 francs to the £. Which is the higher price, 4 francs a metre or 3s. a yard, and by how much in centimetres per metre and in pence per yard? Ans. 4 francs per metre.

(6) After a hem 4 millimetres broad has been made on each of two opposite edges, a handkerchief measures half a metre on each side. The material was sold in a roll half a metre broad at 2·65 francs per metre of length. Find the cost of 100 handkerchiefs. Ans. 1360·8.

(7) An oblong floor is 19·685 metres long by 11 yards broad. Taking a metre to be 39·37 inches, find how many men can be accommodated on this floor if each man requires for himself 1·8 square metre. Ans. 110 men.

(8) Supposing that a metre = 40 inches, express 1 metre as the decimal of a mile, 1 square metre in square feet, 64 cubic inches in cubic metres. Ans. ·00006; 11½; ·001.

(9) Find how much in francs it will cost to carpet an oblong floor 12 metres by 8 metres with carpet ¾ of a metre wide, sold at 10 francs per metre of length. Ans. 1440 francs.

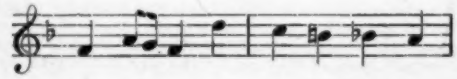
How many decametres make 2000 decimetres? Ans. 20.

(10) Taking a metre to be 39·37 inches, how many metre lengths can be cut from a tape 20 yards long, and what length in inches will be left over? Ans. 18; 11·34.

6. *Drawing.*—One or two freehand copies each week, and one or more groups of models. In drawing the latter attention must be paid to the rules of perspective, the elementary principles of which should be studied. The student should also practise sketching common objects—(1) from the objects themselves, (2) from memory; *e.g.* a garden roller, watering-can, cup and saucer, jug, &c.

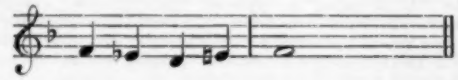
7. *Music.*—Translation of a short passage into Tonic Sol-fa. There is little difficulty in this if a little care is taken. The writing must be accurate, measure and pulses properly divided.

E.g.:—



Sol-fa. Key F.

{| d :m .r | d :l | s :fe | fa :m }

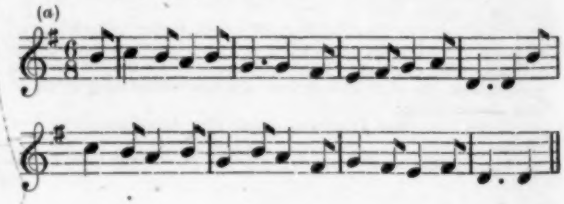


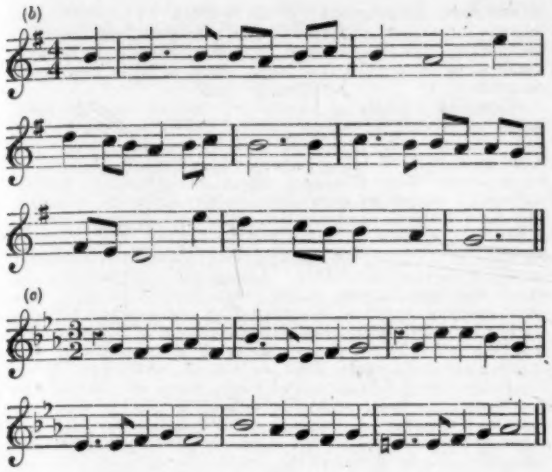
{| d :ta, | l, :te, | d :— | — :— ‖

Take care to put in the proper octave marks.

Write the following in Sol-fa:—

(*a*)





PART II.

1. *English Grammar and Literature.*—Work for the month.
   (*a*) Revise the grammar of the adverb.
   (*b*) Abbott and Seeley—Part II., chapter ii.
   (*c*) Read *Hamlet.*
   (*d*) Next twenty poems in the *Golden Treasury.*
   (*e*) Read *The Last of the Barons* (Lytton).
   The Black Arrow (Stevenson).

Notes.—(*a*) Learn a good classification of the adverb. Note that it modifies a verb, adjective, or another adverb, or anything equivalent to them. Some grammarians say that the adverb modifies a preposition in such a case as "Just beneath the floor," but it is perhaps preferable to consider *just* as modifying the whole of the phrase "beneath the floor."

Note also the relative adverbs *where, wherein, whereby, wherefore,* etc.—"The house wherein I was born = the house *in which* I was born"—and the proper use of here, hither, hence; where, whither, whence; there, thither, thence. *Yes* or *No* are sometimes called adverbs, but they are not so, since it is impossible to find anything they modify when used in answer to a question. These are, strictly speaking, word sentences.

The adverbial use of nouns has been noticed in dealing with case. In such a sentence as "He has gone *home,*" "home" is a noun used adverbially, but it is not an adverb.

There, used when the verb precedes its subject, is an introductory adverb, and not an adverb of place; *e.g.* "There lived a king in days gone by."

The is an adverb in such cases as "The more the merrier."

Passing is an adverb in "This is passing strange," *exceeding* in "He was exceeding glad."

(*b*) The chapter for this month gives some excellent advice on the diction of prose. It should be read and re-read carefully. It will, if properly digested, help the student in his composition. To aim at poetic diction when writing prose is wrong, and it is also wrong to recast a sentence or modify it because it happens to be rhythmical, provided that it expresses the meaning in the best possible way. There are few great writers who do not unconsciously use poetic diction in their writing, especially if they feel strongly on the subject; and in speeches the rhythmical swing of the sentences is decidedly pleasing to the ear. Test your reading by answering the questions on this chapter.

(*c*) *Hamlet* is one of the most interesting of Shakespeare's plays, and one which exhibits his inimitable genius. Shakespeare's characters are real men and not paper creations, and this is particularly true of Hamlet. Was he mad? was he merely assuming madness? The character is so well drawn that it is impossible to decide. The line separating sanity and insanity is so indistinct that it is nearly impossible sometimes to decide on which side a person may be. And so it is with Hamlet; a strong case can be made of his words and actions to prove that he had lost his reason, but then as strong a one can be adduced that he had not.

(*d*) Lytton's *Last of the Barons* deals with the king-maker and the part he played in contemporary history. Although not historically correct, the book nevertheless presents to the reader a very clever picture of English life at the time of the Wars of the Roses. The complex character of Edward IV. is well drawn. In the face of grave dangers and difficulties he was a man of indomitable energy, brave, self-restrained, and abstemious; secure in the Court he was an indolent sensualist.

2. *History.*—For this month prepare the Lancastrian and Yorkish kings to 1485.

Notes.—The reign of Henry IV. was far from being a peaceful one. Elevated to the throne by the combined action and assent of the Barons, the Church, and the Commons, Henry had to yield privileges to each party. The Barons were restless under the rule of a king who was but yesterday one of themselves, and the numerous revolts testified their objection to the Lancastrian yoke. The Church obtained the passing of the *Statute Heretico Comburendo* to put down the Lollards and the growing demand for Church reform; while the Commons demanded and obtained a greater power over the purse of the nation than they had ever exercised before.

Henry V. wisely united the hostile barons by directing their energy against France. His early death altered the entire history of both England and France. Henry VI., more fitted to wield the crozier than the sceptre, saw all the French possessions lost and the country divided by civil war.

The text-book will provide most of the ordinary facts, but the following notes should be carefully studied:—

(1.) *The Growth of the Power of the Commons.*—It has been previously pointed out that De Montfort was probably unaware, when he summoned two burgesses from each important town to his Parliament, of the importance of the step. The union of the knights of the shire with the merchants of the town was the beginning of the great middle class since so important in England. The palmy days of feudalism were fast drawing to a close, the power of the sword was being overcome by the power of money, and the baron in his gloomy castle was not so well housed and served as the merchant in his hall. The Government recognised early that it was from the towns that they could expect to raise money; the nobles (many of them) were impoverished. It was only natural that the men who supplied the money should want a voice in its spending. In 1401 the Parliament claimed Freedom of Speech and also that grievances should be redressed before grants were made. In 1404 an attack was made against the expenditure of the king's household, and the Unlearned Parliament (so called because lawyers were excluded), proposed to confiscate the temporalities of the clergy for one year. Two years later a Continuous Council was formed to advise the king, and the right of auditing accounts was obtained; and in 1407 the important principle was enunciated that grants of money made by the Commons were not to be altered by the House of Lords nor discussed in the presence of the king. The Commons were at this time fairly representative of the country. Under Henry VI. the king's council encroached upon the privileges of the Parliament, and in 1430 a measure was passed which curtailed the growing power. In boroughs, members of Parliament were to be elected not by the freemen but by the council, or a select portion of it, and the county franchise was restricted by allowing no one to vote who did not possess a freehold of 40s. per annum. This took from the people the right of election, which was only returned to them by the Reform Bill of 1837.

(2.) *Loss of the French Possessions.*—The battle of Agincourt, though a crushing defeat for the French, was no more a conquest of France than the battle of Hastings was of England. The Treaty of Troyes, which made Henry Regent of France and recognised him as successor to Charles, was not a confession of French incapacity and defeat. And the loss of the French possessions by England was not brought about by the heroism of Joan of Arc, by the rivalries of the English regents, or a revival of French courage, although these things may have assisted. The keynote of success and failure was the attitude of the Duke of Burgundy. The province of Burgundy occupied the north and west of what we now call France, together with parts of Belgium and Germany. The Duke of Burgundy was a noble hardly less rich and powerful than the King of France himself. The murder of John Duke of Burgundy in 1419 at Montereau, in the presence of, if not by the orders of, the Dauphin, led to an alliance between England and Burgundy. Together they were more than a match for France, but England was much weaker than Burgundy and France united. The Regent Bedford recognised this. In 1422 he married the sister of Philip of Burgundy, and this strengthened the alliance. Two years later the Duke of Gloucester married Jacqueline of Hainault without the consent of her feudal superior the Duke of Burgundy, and endeavoured to assist her claims by force of arms. In 1432 the Duchess of Bedford died, and Bedford married Jacquetta of Luxembourg without Burgundy's consent, and when in 1435

Bedford died, the Burgundian Alliance died with him. From this time the final defeat of the English was certain.

(3.) *Cause of the Wars of the Roses.*—Richard Duke of York had no *right* to the throne. There was no law of primogeniture, though the custom was usually followed, and the Parliament still claimed the right to elect the sovereign. As Henry IV. was made king by the Parliament, he was king *de jure* as well as *de facto*. Had Henry VI. been an average strong king, or had he remained childless, there would have been no civil war. Failing the Lancastrian line, York was the next heir, and as eight years elapsed without an heir being born to the king, he began to look upon the succession as assured. The sweets of power tasted by York during his Protectorship increased the desire, and it was only when the birth of a son to Henry barred him from the succession that he asserted a *better* right than the king himself. The action of the Somersets made it imperative, either to yield up all power and probably die in prison, or to make a bold fight for the crown. The latter course was adopted and hostilities commenced.

There are some features of these wars which must be noted. (1) They were carried on by the nobles and their retainers; the towns and the people generally were not affected. (2) They were waged with unexampled ferocity; personal feuds and revenges destroyed the ordinary laws of chivalry. (3) They were the final blow to the Feudal System.

Citizenship.—Prepare chaps. v., vi., vii., and viii. (Peaker's *British Citizenship*).

The House of Commons—Representative and Party Government—Taxation—Making an Act of Parliament.

Special Period.—The reign of William IV. (**1830 to 1837**).

The chief interest in this reign centres in the great Reform Bill. The questions upon which you must satisfy yourself are—(1) Why was Reform necessary? (2) Why was it opposed? (3) How was it effected?

(1) Reform was urgently needed. The House of Commons was theoretically supposed to represent the Commons of England; in reality it did nothing of the kind. We have seen (*supra*) that the election in the towns was limited, and that in the country the imposition of a property qualification prevented any of the poor from voting. In addition many towns once flourishing had sunk to mere villages, while great manufacturing towns in the North had sprung up. The latter were unrepresented in Parliament.

(2) Why was it opposed? Presumably because in the Commons many members were asked to vote for the disenfranchisement of the place they represented, and in the Lords, because they had control of pocket boroughs where they could return what men they liked; and, secondly, because the Government, or at any rate many of the upper classes, were afraid of trusting the people, who were comparatively ignorant. Any important reform in England is always met by the cry that the nation is going headlong to ruin.

(3) The exact details must be learned—the number of seats taken away, and how they were redistributed.

The immediate effects of the Reform Bill may be seen in the measures passed:—

1833. Abolition of Slavery at the cost of £20,000,000.

1833. The Factory Act, limiting the number of hours' work per day for women and children, and the provision for the education of the latter.

1834. Poor Law Amendment. The Poor Laws had hardly been altered since the Great Poor Law of Elizabeth—each parish maintaining its own poor, so that a poor parish staggered under a heavy burden, and a well-to-do parish had none at all. The system of indiscriminate outdoor relief had increased pauperism, in fact a man with wife and several children could obtain more from the parish than he could from work. This was altered. Unions of Parishes were established, which reduced working expenses, and equalised the poor rate, and discrimination was made between the idle and the unfortunate.

The Melbourne Administration also passed the Municipal Corporation Act, which did for the boroughs what the Reform Bill had done for the country.

3. *Geography.*—Work for the month.

(1) The motions of the earth; (*a*) Diurnal round its own axis; (*b*) Annual or Orbitual round the sun; (*c*) Succession of the Equinoxes; (*d*) Revolution of the Apsides.

General comparison of the land masses or continents.

(2) Prepare in detail Italy and Switzerland.

(3) The Geography of Canada.

In preparing or revising Italy and Switzerland, make free and continual use of sketch maps, until you can draw a good sketch map from memory, and insert all places of importance if you do not know the geography of the country. The productions, imports and exports, connections with other countries, the towns and governments must receive greatest attention. Beyond the usual facts in a good text-book, there is little that needs comment.

Switzerland consists of twenty-two cantons, and the population is formed of three nationalities — German, French, and Italian. The parliament consists of two chambers—a national council of 147 members, and a council of states of 44 members. Both chambers united are called the Federal Assembly. About one-sixth of the country is covered by forests. The main textures comprise silk, cotton, woollen, lace, thread, clocks and watches at Genoa and Neufchâtel, leather, gloves, cheese, etc. There are many home industries, particularly wood-carving and lacemaking. Agriculture is carried on in the valley, and dairy farming on the lower slope of the Alps. The chief industry, however, is entertaining the tourist. Switzerland has properly been called the playground of Europe, and it is little wonder, for the scenery passes all description.

Italy has been since 1870 a limited monarchy. When the Roman Empire crumbled to pieces, Italy was divided into provinces and states, which throughout the Middle Ages and down to last century maintained a continual warfare with each other, and were in turn subject to Spanish, French, and Austrian influence. In the middle of the nineteenth century it was composed of the States of Sardinia, the two Sicilies, the Pontifical States (governed by the Pope), Lombardy, and Venice (under the Austrians), the Grand Duchy of Tuscany, and the Duchies of Parma and Modena. A movement for United Italy, in which Garibaldi acquired his fame, was set on foot, and after a century Italy became, in 1870, for the first time for many centuries, a united kingdom. Since that date the progress has been great. Agriculture is the main industry. The Government is similar to ours.

Canada.—There is probably no other country so rich in natural wealth and possibilities and so poor in population as Canada. From the coast provinces of the Atlantic to the pine-clad shores of the Pacific, from the prairies of the south to the vast forests of the north, there is every variety of land and scenery, all habitable, with a healthy climate, well watered, and waiting for occupation. In over three million square miles of country there are fewer people than in London. It is doubtful whether there is any other country where a man could with the same expenditure of labour so quickly realise a competence.

The geography requires careful study; much interesting and pleasant reading will be found in the handbooks issued gratis by the Dominion Government and by the Canadian Pacific Railway.

Understand clearly what is meant by the "Dominion." The various eastern colonies were founded at various times—St. John's, Newfoundland, in 1613; Nova Scotia, 1623; Prince Edward Island was made a separate colony in 1769; New Brunswick in 1784; Canada was ceded by the French and divided in 1791 into Upper and Lower Canada, to which responsible government was granted in 1841. In 1867, by the British North American Act, the provinces of Canada, Nova Scotia, and New Brunswick were federated under the name of the Dominion of Canada. Three years later Manitoba was admitted, and the North-West Territory added. Columbia joined in 1871; Prince Edward Island in 1873. The north-west provinces have been organised, and the Dominion of Canada includes all the British possessions except Newfoundland. Each province has a government of its own. The Dominion Parliament meets at Ottawa.

4. *Elementary Science:*—

Chemistry.—The effect of heat on paper, wood, coal, feathers, starch, sugar, salt, soda, chalk, iron, copper, lead. Composition and properties of air.

The effect of heat is generally to break up compounds and to reduce bodies to simple forms. The effects can be easily tested. For example, wood consists of carbon, water, tar compounds, and minerals. The first effect of heat is to dry the wood, to drive off the water and some of the other volatile compounds, then the tar distils away, leaving the black carbon, which in the presence of air unites with the oxygen and passes away as carbon dioxide. The ash which is left is composed mainly of minerals. Or, again, chalk is a chemical compound of the oxide of lime, CaO and carbon dioxide CO_2 chemically united as $CaCO_3$. The effect of heat is to split this compound up into CO_2, which passes away, and CaO or quicklime, which remains.

5. *Elementary Mathematics:*—

(*a*) *Arithmetic.*—Proportional parts and partnership. Work as many examples as possible in Christian and Collar, and write for any assistance.

(*b*) *Algebra.*—Division.

(*c*) *Geometry.*—Division of a straight line into equal parts. Construction of triangles equal to polygons.
(*d*) *Euclid.*—Propositions 32–37, with two deductions each week.

Test Questions.

(The answers to these can be marked at a nominal charge by arrangement.)

1. Write as specimens of copy setting:—
(*a*) Large hand.—Crystallography.
(*b*) Small hand.—Coblentz and Ehrenbreitstein are on the banks of the Rhine.

2. Work the following:—
(1) Find by practice the exact cost of 3·62 metres of cloth at 5 francs 60 centimes per metre. Ans. 20·272 francs.
From your result deduce the value of the same quantity of cloth at 4 francs 80 centimes per metre. Ans. 17·376 francs.
(2) Perform each of the following calculations in the most intelligent way you can:—
(*a*) £9, 19s. 7d. × 99 – £9, 19s. 8d. × 98. Ans. (*a*) £9, 11s. 5d.
(*b*) G.C.M. of 18 × 19 and 19 × 27. Ans. (*b*) 171.
(*c*) Square root of 1002001. Ans. (*c*) 1001.
(3) A certain number is divided by 3, the quotient by 5, and that quotient again by 7. The final quotient is 329, and the partial remainders are 1, 2, and 1. What was the number divided. Ans. 34567.
(4) Find as intelligently as you can the total amount of the following bill, showing all your methods of calculating. You may combine items.
135 eggs at 2s. 3d. per score.
135 eggs at 1s. 9d. per score.
110 lbs. of butter at 1s. 7½d. per lb.
106 cakes at 11s. 3d. a dozen.
220 lbs. of lard at 8¼d. per lb.
318 lbs. of biscuits at 4s. 3d. per dozen lbs. Ans. £28, 9s.
(5) Three pieces of cloth, 20, 30, and 45 yards long respectively, cost altogether £7, 8s. 9d. A yard of the first cost 2d. more than a yard of the second and 3d. less than a yard of the third. What is the price per yard of each. Ans. 18d. 16d. 21d.
(6) What maximum start in a mile race should a cyclist whose record is 3 mins. 15 secs. give to another whose record is 3 mins. 20 secs., assuming that the pace is uniform over the course?
Ans. 44 yds.

3. Explain the difference between Poetry and Prose. Quote and scan four lines of any poem.

4. Say what you can of Touchstone and the part he plays in *As You Like It*.

5. Describe with a plan how the battle of Plassey was won.

6. Explain clearly the causes which led Edward I. to interfere in Scotch affairs.

7. Say what you can of the causes and results of the Peasants' Revolt (the story of the rising need not be given).

8. What are the advantages of possessing a House of Lords? In what respects might it be improved?

9. Explain as fully as you can what causes a volcanic eruption, and what is usually ejected during an eruption.

10. What industries have developed of recent years in India? Why are famines less severe than they were some years ago?

11. How would you make and graduate a thermometer? Why should not coloured water be used instead of mercury?

12. Work the following:—
(1) Simplify $3x^2-[(3x-7)(x+1)-2\{(x+3)(x-3)-(x+1)^2\}]$.
Ans. –13.
(2) If $a=-3$, $b=5$, $c=-1$, find the value of
$$3a\sqrt{3ab+46}-2bc\sqrt[3]{a^3-5b+12c}.$$
Ans. –49.
(3) Simplify $\frac{5a}{2}-\frac{21b}{2}-3[\frac{1}{3}b-2\{\frac{1}{4}a-b-3(\frac{2}{3}a-\frac{1}{4}b)\}]$.
Ans. $\frac{1}{4}a-2b$.
(4) When $a=\frac{3}{4}$, find the value of
$$\frac{\frac{1-a^3}{1-a}+\frac{1+a^3}{1+a}}{\frac{1-a^3}{1-a}-\frac{1+a^3}{1+a}}$$
Ans. $\frac{3}{4}$.

All students are invited to write for assistance on any matter connected with this Course. Letters should be sent to Mr. A. T. FLUX, Belvedere, Kent, and must contain the coupon of the current number of the paper, with a stamped addressed envelope if a reply is needed by post.

OUR CERTIFICATE COURSE FOR 1907.

BY GEORGE COLLAR, B.A., B.SC.,
Head-Master of Battersea Pupil-Teacher School.

Test Questions on Last Month's Work.

PRINCIPLES OF EDUCATION.

1. How is the general principle that we should in teaching "proceed from the simple to the complex" explained and illustrated in the text-book or in your own experience?

2. Give some examples of legitimate and illegitimate forms of questioning, and give a few rules for the guidance of young teachers in the art of questioning.

3. What do you mean by "method"? Show in what way method must be varied.

4. Write full notes of a lesson on one of the following topics, showing (*a*) for what class of scholars it is intended, (*b*) what visible or other illustration would be required, and (*c*) what is the educational object aimed at:—
(i) The Savings Bank.
(ii) Some simple rules for preserving health.
(iii) The use of metaphors.
(iv) Plants used as food (*for an infant class*).

ENGLISH LITERATURE.

1. Compare Coleridge and Tennyson as illustrated by *The Ancient Mariner* and *Christabel*, and by *The Coming and Passing of Arthur*, *Ulysses*, *Tithonus*, *The Lotos Eaters*, and *Oenone* respectively.

2. Contrast some of the Athenian customs as shown in Act i. with those of our own country.

3. In what points do you think that Shakespeare has drawn the "rude mechanicals" in Scene 2 true to life?

ENGLISH HISTORY.

1. Trace the rise of the temporal power of the Roman Church.

2. Explain clearly what changes in English institutions and social conditions had taken place between the time of Alfred and that of Harold II.

3. Describe the objects and provisions of the Assize of Clarendon, the Assize of Arms (Henry II.), and the Statute of Winchester.
How far did any of their provisions revive Anglo-Saxon institutions?

GEOGRAPHY.

1. What do you mean by a "projection"? Describe the chief ways of projecting a map, and point out the chief advantages and disadvantages of each.

2. In what ways can the vertical configuration of a country be indicated on a map?

3. A class is beginning to study the geography of Spain. Set down briefly the chief points which the children could discover for themselves by the aid of a good relief map.

ARITHMETIC.

1. The operation known as division may be one of "measuring" or one of "sharing." Give four sums, two illustrating "measuring," and two illustrating "sharing." Work your sums.

2. Every item in the multiplication table expresses a relation between three numbers, which enables us to find any one of them when the other two are given. Write down in words, as few and simple as possible, the three questions which have for their respective answers the three numbers in the statement—"four nines = thirty-six."
Give an example of the practical application of each of these.

3. Point out the error of style in the following solution to

the question: "How much is the sum of 9d. and the half of 5 guineas?"

½ of £5, 5s. = £2, 12s. 6d. + 9d. = £2, 13s. 3d.

Correct this error without abandoning the equation form.

Algebra.

1. In what ways does Algebra differ from ordinary arithmetic?

2. From *a* pounds *b* shillings *c* pence is taken away a less sum, namely *c* pounds *b* shillings *a* pence. The remaining money is spent in buying loaves at $(a - c)$ pence apiece. How many loaves are bought?

Geometry.

1. Draw an irregular seven-sided figure and then draw a triangle equal to it in area.

2. Divide a given straight line into seven equal parts and explain your construction.

Elementary Science.

1. Explain clearly and fully how you would teach children the differences between the three forms of matter.

2. State the Law of Boyle or Mariotte and describe an experiment by which it can be proved. A diving-bell contains 75 cubic feet of air and is lowered into a tank 10 feet deep. How many cubic feet of air must be pumped in so as to keep the bell full of air? [Assume that the pressure of 33 feet of water is equal to the pressure of the atmosphere].

Notes and Syllabus for September.

Composition.

Prepare chapters vi., vii., and viii. of *The Art of Writing English*, or chapter v. of Nesfield's *Senior Composition*. There is a great deal to be gained by the careful study of this section. It is true that if we take up a book written by some deep thinker or by a great discoverer in science, we are prepared to expend a good deal of thought in order to arrive at the exact meaning of what he has written. But it is only those who are known to be deep thinkers, or who are renowned for their knowledge, who can expect their readers to take this trouble. The rest of us must take pains to make our meaning as clear as possible to those who have to read what we set down. The chapters we have set for study point out the chief ways by which this may be done.

Prepare essays on the following subjects, and put into practice the precepts given in the chapters set:—

1. Warwick, the King-maker.
2. Bee-keeping.
3. Glaciers.
4. "The gods are just, and of our pleasant vices
   Make instruments to scourge us."—*King Lear*, v. 3.

Principles of Education.

A careful study should be made of the methods of teaching reading as set out in Collar and Crook's *School Management*. As far as the writer can judge, there seems to be a great falling off in the teaching of reading. Some teachers do not realise what they have to aim at, and hence a very great deal of the reading is lacking in intelligence, and after a boy has read a sentence he is too frequently unable to tell what he has been reading about. This is, of course, the most serious part of the subject, for, as stated in the text-book, only a very small percentage of our reading consists of reading aloud, and if the meaning is not grasped it follows that what is supposed to be silent reading, or reading to one's self, is absolutely nothing at all.

The power of reading aloud is by no means to be despised, because it comes second to ability to grasp the writer's meaning. On the contrary, it requires a great deal of skill on the part of the teacher. The correct method of producing the voice must be carefully studied, and so must the mechanical processes employed in articulation. These are all set out in the chapter, so it is unnecessary to repeat them here, but the student must make experiments and observations on his own vocal organs, more particularly his tongue, lips, and teeth, in order that he may help those of his pupils who have any difficulty in their speech.

English Literature.

Read carefully Charles Reade's *Cloister and the Hearth*. This is published in a cheap and convenient form bound in cloth in the series of Nelson's Sixpenny Classics. This book is of great interest on account of the narrative itself. It is of still greater value on account of the information it gives respecting bygone days. Among the matters to be noted in the *Cloister and the Hearth*, which will throw light on other books the student may read, are:—the pictures of domestic life in a citizen's house in the Middle Ages; the relations between the different classes of society; the forest laws and game laws; the relation of Church to Society; the insecurity of life and property in spite of the heavy penalties inflicted on malefactors; the state of the medical profession; the abundance of vagrants and their methods of obtaining a living; and finally, the great movement of the Renaissance, with which the student is brought into contact in reading the account of Gerard's visit to Italy.

Make a point of reading a poem from the anthology every day and trying to remember as much of it as possible.

Study in detail the Second Act of *A Midsummer Night's Dream*.

Scene i. line 9. *To dew her orbs.* The student is familiar with the rings of fresh grass which are seen in fields and on commons, and which are called "fairy rings," from the idea that they were the rings in which the fairies danced during the night. The fairy says that her duty is to water these with dew.

13. *Live their savours*, resides their perfume. Savour properly means taste, but we think we recognise a characteristic taste in a perfumed object when we are eating it, *e.g.* a rose lozenge; but a person who was unable to smell could taste only sweetness. Very often a disagreeable medicine loses its "taste" if you pinch your nose so as not to smell it when you are taking it. This shows the connection between smell and taste, and explains the use of "savour" to denote smell in this line.

16. *Lob*, clumsy fellow.

20. *Wrath*, here used for the adj. *wroth*, for the sake of the rime.

35. *Skim, labour, make, mislead*, these verbs should be in the *third* person singular.

36. *Quern*, also spelt *Kern*, a hand-mill for grinding corn. For the tricks supposed to be played by fairies, see also Milton's *l'Allegro*.

38. *Barm*, literally *yeast*, here "froth" or "head."

46. *Filly foal*, a female colt.

50. *Dewlap*, the loose skin and tissue under the neck of a cow, here used for the wrinkled neck of an old woman.

69. *Steppe*, a plain, from the Russian. Some texts have *steep*, *i.e.* mountain.

91. *Pelting*, paltry; cf. poor, pelting villages (*King Lear*, ii. 3), not connected with "pelting rain," which is from Latin *pello*, I drive.

92. *Continents*, the banks which *contain* them.

94. *Lost his sweat*, laboured in vain.

97. *Murrion*, dying; cf. *murrain*, a deadly disease, Latin *mors* = death.

109. *Hiems'*, winter's

121. *Henchman*, servant, attendant, or groom, probably from A.S. *Hengst*, or *Hengest*, a horse.

150. *Dolphin*, a sea animal, like the porpoise and whale, which has lungs.

192. *Wood*, mad.

233. *Bootless speed*, speed that brings no advantage; cf. Is there no boot? (*King Richard II.*)

250. *Grows*, it should be "grow," plural.

256. *Weed*, garment; cf. "widow's weeds," and

"Stately dames and barons bold
In weeds of peace high triumphs hold."

Scene ii. line 1.—*Roundel*, a ballad in which a line comes *round* again and again.

4. *Rere-mice*, bats.

13. *Philomel*, the nightingale; cf.—

"By this lamenting Philomel had ended
The well-tuned warble of her nightly sorrow."

30. *Ounce*, a kind of lynx.

126. *Nor never can.*—Two negatives did not originally make an affirmative, but a stronger negative.

English History.

Continue the study of English History to the accession of Henry IV. Pay close attention to constitutional questions. No doubt the wars and personal history of the kings are familiar to

you; now study the social condition of the people and the changes which have led to the development of our present constitution.

It is estimated that the population of England at the Conquest was between one and a half and two millions, and in spite of the arrival of about a quarter of a million of immigrants from the Continent under the Norman dynasty, the population actually decreased before the death of Stephen. This shows the hardships to which the people were subjected.

Henry II. did much to improve the lot of the common folk by demolishing the "adulterine castles." He also introduced the principle of bringing justice to every man's door, or as near to it as possible, by appointing "Justices in Eyre."

The quarrel between Henry II. and the Church is generally well known.

The general subject of the Crusades should be read up by itself. Not merely should a list of the expeditions be remembered, with those who took part in them, and their results, but the broader effects of the movements should be noted: the use made of them by the Popes for strengthening their temporal power; their effect on the march of civilisation; and the establishment of the Military and Religious Orders. Under Pope Innocent III. the army of the Cross, raised to rescue the Holy Land from the Mahometans, was used first to make war upon the Christian kings of Hungary, and then to carry on a fiercer war against the Christian emperors of the East. Pious Christians were stricken with horror to find the fourth Crusade employed in conquering Tara for the Venetians, and then besieging and conquering the then Christian city of Constantinople, whose inhabitants they treated with barbarous cruelty.

It seems at first sight as though the only results of the Crusades were the sacrifice of many lives and much treasure upon unsuccessful military enterprises, and the introduction of harsh measures of taxation to raise the necessary money. But every country of Europe, including our own, profited in the direction of political liberty among the masses of the nation. Kings and nobles were glad to sell rights of municipal self-government to towns in their domains, and the influence of the commercial classes was increased by the sale to them of land, and also by the commercial activity awakened by the Crusades. The common opinion is that the Saracens were half savages, but the fact is that their civilisation was superior to that of Western Europe. Hence the Western nations gained by the contact. The introduction of many comforts and luxuries has been recorded, and no doubt we owe many more things to Eastern civilisation than have been accounted for by historians. Silk and sugar were both introduced from the East, and such an invention as the windmill owes its origin to the dry country of Asia Minor, whence they were first introduced into Normandy in 1105.

The institution of the two Military and Religious Orders of the Knights Templars and the Knights Hospitallers of St. John of Jerusalem formed the fighting elements of Europe into two small but highly efficient standing armies for the defence of the Christian cause in the Holy Land. The members of these orders took the monastic vows of chastity, poverty, and obedience, together with the military vow that they would wage unceasing war against the misbelievers, and would afford unfailing protection to Christian pilgrims. Many of the nobles joined them and assigned their land to their order. But as the wealth and power of the orders increased the purity and humility of the members diminished, though they kept up their martial character. When the Christian power was finally overthrown in Palestine, the order of the Templars was destroyed, mainly through the rapacity and cruel treachery of Pope Clement V. and of Philippe le Bel of France. The Knights of St. John, however, established themselves at Rhodes and at Malta, and continued valiantly to oppose the Mahometan advance. The feudal customs were also favourable to chivalry, which was fostered in the baronial castles.

The feudal system forms another independent subject for study. Too frequently the student regards it as a system by which the vassal merely held land on condition of rendering certain services and paying certain sums of money. The mutual obligations should be carefully noted. The vassal was bound to render military service (afterwards commuted to payment called *scutage*), to attend the lord's court of justice if he held one, to give faithful counsel, and show respect to his lord's honour and person. The occasions and amounts of the money payments were frequent sources of contention between the lord and vassal, but in most cases they were reduced to three (called *aids*), viz. to rescue the lord from captivity, to provide a dower for his eldest daughter on her wedding, and to pay for the costly ceremony and entertainment when his eldest son was knighted.

The lord for his part was bound to afford protection to his vassals against all wrongdoers, and it was this need of protection which induced small free landowners on the Continent to make over their lands to a powerful neighbour and receive them back in feudal tenure. In the case of the vassal dying without heirs, the land reverted or *escheated* to the lord, who also had the right to declare the land *forfeited* to himself in case of certain acts of misconduct. When an heir succeeded to an estate he paid a sum called a *relief*. If the heir was a minor, the lord acted as his guardian and took possession of the land during the heir's minority, and in some countries he had the right to choose a consort for his ward, who was bound to accept the mate proposed or pay a sum of money.

Under the English system, every landowner, whether he held the land directly or indirectly from the king, was bound to do homage directly for it. He was also pledged not to engage in any private warfare, although this pledge was not always kept.

GEOGRAPHY.

Study carefully the physical geography of Europe. The general build is fairly simple when once the somewhat intricate coast-line has been mastered, but yet the details of the relief is somewhat complicated. There is an isolated mass of elevated land forming the peninsula of Norway and Sweden. The western portion of this is much higher than the eastern, and the river valleys are very deep, having been formed by the action of glaciers. The fjords, which form such a characteristic feature of the west coast of Norway, are merely extensions of these narrow valleys, and have been hollowed out in the same way. This is proved by the fact that many of the fjords are much deeper than the open North Sea. If the depressions had been worn out by the action of rivers, the débris could not have been raised to a greater height than that from which it was brought down. The Buerbrae and Bondhus Glacier, coming down from the great snowfield called Folgefond, are but small remains of the mighty glaciers that once existed in those districts.

The other elevated mass, often spoken of as the Alpine System, bears traces of fairly recent glacial action in its upper portions. The higher valleys have largely been formed by glacier action, but river action has done a good deal, and the lower regions and plains seem to owe their form to rivers alone. In studying the general build of a country or continent, the student must bear in mind that the mountains have not been piled up, but the valleys have been hollowed out from the general mass of elevated land, and the mountains are the parts still standing high. This accounts for the very irregular course of the watershed and for the way in which the valleys seem to be interlocked. We will just run briefly through the European mountain system. The mountain ranges of Spain run in a general direction from south-west to north-east. They include the Sierra Nevada, Sierra Morena, Mountains of Castile (Sierra de Gata, Sierra de Gredos, and Sierra de Guadarrama), and the Cantabrian Mountains, which are continuous with the Pyrenees. The high land in the south of France is cut in two by the valley of the Rhone, the watershed of which on the west is formed by the Cevennes, Cote d'Or, and Plateau of Langres; it then crosses to the Vosges and Jura. About half-way down the latter it follows the Bernese Alps (with the Jung-frau, Monch, Eiger, and Finsternarhorn) to Mont St. Gothard. The mountain system of Italy is very simple, the Apennines forming the backbone of the peninsula; these are continued into the Maritime Alps, which run west and shelter the Riviera, or district along the coast of the Gulf of Genoa. North of these come the Cottian and Graian Alps, with Monte Viso and Mont Cenis. Next comes the Mont Blanc group, an immense mountain mass from which the Pennine Alps run eastward. This mass is about sixty miles long and from fifteen to twenty broad, with numerous transverse valleys, mostly opening northwards into the Rhone valley, and leaving such peaks as the Great St. Bernard, Dent Blanche, Weisshorn, Matterhorn, Breithorn, Lyskamm, Monte Rosa (the second highest peak in Europe), and the Michabel, of which the peak called the Dôm is the third highest point in Europe. This mass is separated from the Bernese Alps by the deep valley of the upper Rhone, and the two join at the Furka Pass near Mont St. Gothard, the central point of the Lepontine Alps. From this great centre the high Engadine valley (6000 feet) runs eastward to the Tyrol. The chief ridge flanking this is called the Rhaetian Alps, and contains the peaks Piz Languard, Piz Bernina, and Ortler Spitz. East of the Tyrol the mass divides; the south-eastern chain is formed by the Carnic and Julian Alps, which are continued by the Dinaric Alps and the plateau of Montenegro and Herze-

govina into the mountain chains of Turkey and Greece. To the north-east the elevation is continued through the Noric Alps to the Little Carpathians, to the north-west of which lies the table-land of Bohemia, surrounded by the Bohmer Wald (south-east). Erz-Gebirge (north-west), and the Riesen Gebirge and Sudetic Mountains (north-east). Thence running round Hungary come the Carpathians and the Transylvanian Alps; and though the Danube breaks through the chain at the Iron Gate, they are really continuous, through the Planina Mountains, with the mountains of Turkey and Greece.

Arithmetic.

Revise the theory of G.C.M. and L.C.M., and master the work on Vulgar Fractions. A thorough grasp of the theory of this part of the work is of the highest importance.

Algebra.

Go to the end of chapter vii. in the *New Algebra*, paying special attention to all points of theory and to shortened methods of working.

Geometry.

Methods of drawing a tangent to a circle (*a*) from a given point on the circumference; (*b*) from a given point outside. To draw a circle of given radius to touch a given line at a given point. To draw a circle through a given point and touching a given line in a given point. To draw a circle passing through three given points. In the theoretical section master the theorems on the congruency of triangles (all cases).

Elementary Science.

Study the chapter on the so-called mechanical powers. It will be noticed that the term "power" is very loosely used in this part of the work. We shall see presently that "power is the rate of doing work," and shall inquire into the full meaning of the phrase; but we must point out that it is inconsistent with this definition to call the lever and the pulley mechanical powers. In the same way it is inconsistent to use the term power to denote the *force* which is applied to a machine in order to raise a weight.

The section on motion usually presents considerable difficulty, owing to the want of clear conceptions of the fundamental points. If we define motion as "change of position," we are then led to inquire what we mean by position, and we find that all position is relative, *i.e.* a body has position only in relation to other bodies, *e.g.* if there were only one body in the universe it would be impossible to define its position, and consequently we could never say that such a body moved. If there were two bodies we could say that they became nearer together or farther apart, but could not say which one had moved, or rather we could say with equal propriety that either of them had moved. This explains the illusion respecting the motion of a train when for the time being we are aware of the existence of only our own train and another one. It must be borne in mind, too, that the amount of motion is simply the amount of displacement of the body, and has no reference whatever to the *time* during which the displacement has been taking place. Thus, if one body is two feet from the place in which we last saw it, and another one is four feet from the place in which we last saw that, we say that the second body has moved twice as far as the first, even if a year has elapsed between the two observations made upon it, and only a minute in the former case.

If we take into account the *time* during which the motion takes place, or calculate the amount of motion that takes place in a unit of time, then we come to deal with *velocity*. The numerical measure of the velocity of a body is the number of units of distance travelled in one unit of time. Consequently the number representing the velocity of the same moving body will differ greatly according to the units of time and distance taken. Thus a body may be said to be travelling at 12 feet per second or at $8\frac{3}{11}$ miles per hour.

If the body travels equal distances in equal short intervals of time, the distance travelled will be proportional to the time taken, and we say that the body is moving with a *uniform velocity*. In other cases the body is either gaining speed or losing it, and we say that its velocity is *accelerated* or *retarded*.

If a body is moving at the rate of 30 feet per second when first observed, and at 40 feet per second when next observed, we see that it has gained in velocity 10 feet per second, but unless we know how long it has taken to acquire this extra 10 feet per second velocity we are ignorant of a very important factor. One body might gain 10 feet per second in a second, while another might take a minute to gain the same increase of speed. Hence in defining *acceleration* we must not only say how much velocity has been gained, but also say in what length of time it has been gained. We might talk of an acceleration at 10 feet per second in a minute, or of 5 miles per hour in a minute, but we generally adopt the same unit of time in both cases and talk of an acceleration of 10 feet per second per second. The double reference to the time is rather confusing to beginners, especially when they are asked to change from one unit to another in denoting the same acceleration.

Example.—The acceleration of a body is denoted by 10 when the foot and second are the units, by what would it be represented if the mile and minute are taken as the units?

This is best reasoned out step by step thus: an acceleration of 10 feet per second per second.

$$= \frac{10}{3 \times 1760} \text{ miles per second per second.}$$

$$= \frac{10 \times 60}{3 \times 1760} \text{ miles per minute per second.}$$

$$= \frac{10 \times 60 \times 60}{3 \times 1760} \text{ miles per minute per minute.}$$

$$= \frac{10 \times 60 \times 60}{3 \times 1760} = 6\tfrac{3}{11}.$$

Ans. $6\frac{3}{11}$ miles per minute per minute.

Having mastered the idea of acceleration, the student will the more easily grasp that of *force*. Now, force is defined as that which alters, or tends to alter, the state of rest or of uniform motion in a straight line of a body. Thus, if a body is at rest, that which makes it move is a force; if a body is moving in a straight line, that which makes it come to rest, or move more or less rapidly, is a force. If it is made to move in a curve instead of a straight line, a force is necessary, *e.g.* if a weight be swung round at the end of a string, the string exerts a pull on the weight, and if the string breaks, the body abandons its circular motion and flies off in a straight line.

Now, if a force is thus defined, we see that there are two elements required to be known before we can compare forces. Suppose two equal trains to be at rest, and that the engines begin to work, then if at the end of a minute one is moving at twelve miles an hour and the other at six miles an hour, we should say that the engine of the former train was exerting the greater force. Or suppose that two trains both acquire a speed of twenty miles an hour in the same time, then if one train is much heavier than the other, it is evident that its engine is the one which has exerted the greater force. So we see that a force is measured by the amount of motion which it produces, and further, that this *amount* of motion is the product of two factors, viz. the *mass* of the body moved, and the *acceleration* which is imparted to it.

Now the student will be able to understand Newton's three "Laws of Motion," which may justly be regarded as the foundation on which the science of Dynamics (or the laws of moving bodies) rests.

1st Law. Every body continues in a state of rest or of uniform motion in a straight line, except in so far as it is compelled to change that state by the action of an external force acting upon it.

2nd Law. Every change of motion is proportional to the acting force, and takes place in the straight line in which the force acts.

3rd Law. To every action there is always an equal and contrary reaction; or the mutual actions of any two bodies are always equal and in the same straight line but in opposite directions.

Newton gives three illustrations of this law:—

(i) If you press a stone with your finger, your finger is pressed equally hard by the stone.

(ii) If a horse draws a stone fastened to a rope, the horse is drawn backwards, so to speak, with equal force towards the stone.

(iii) If one moving body strikes another moving body, the change in its own motion is equal, but opposite, to the change that it causes in the motion of the other.

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MATHEMATICS.

(STAGES 2 AND 3.)

BY FRANK CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mathematics, etc., Morley College; Author of "Elementary Practical Physics," "Practical Mathematics," etc.

Surds.—The terms irrational quantities, or surds, are usually applied to numerical, or algebraical expressions, in which the root, or roots, cannot be exactly determined.

Examples of surds are to be found in such expressions as $\sqrt{8}$, $\sqrt{18}$, $\sqrt{(1+x^3)}$, etc.

In many cases an expression in the form of a surd may be resolved into two parts (one part rational and the other a surd). This may be effected by separating the quantity into two parts, such that the root of one of them is obtained. Thus—$\sqrt{8}=\sqrt{4\times2}=2\sqrt{2}$; $\sqrt{18}=\sqrt{9\times2}=3\sqrt{2}$; $\sqrt[3]{200}=\sqrt[3]{8\times25}=2\sqrt[3]{25}$, etc.

When the quantity below the root is reduced as low as possible, the expression is said to be in its lowest or most rational terms.

Surds are of frequent occurrence both in algebraical and trigonometrical expressions, and the few rules or methods by which the value of a given surd may be obtained should be carefully made out. It is only possible in this place to indicate a few of the more important cases.

To rationalise a given binomial surd, such as $a+\sqrt{b}$ or $\sqrt{a}+\sqrt{b}$. From $x^2-y^2=(x+y)(x-y)$.

It is easily seen that if $x=\sqrt{a}$ and $y=\sqrt{b}$, then $a-b=(\sqrt{a}+\sqrt{b})(\sqrt{a}-\sqrt{b})$;

$\therefore$ $\sqrt{a}+\sqrt{b}$ will be made rational by multiplying it by $\sqrt{a}-\sqrt{b}$.

Hence to rationalise a given binomial surd it is necessary to multiply by the same surd with the connecting sign changed; this is usually termed the *complementary surd.*

Exercises may be obtained from any text-book on the subject. The following will indicate some of the methods which may be adopted for the purpose.

Ex. 1. Simplify $\dfrac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}}$

given $\sqrt{6}=2{\cdot}4495$.

Multiplying numerator and denominator by $\sqrt{3}+\sqrt{2}$ we obtain

$$\frac{(\sqrt{3}+\sqrt{2})^2}{3-2}=3+2+2\sqrt{6}$$
$$=5+2\sqrt{6}=9{\cdot}899.$$

Square root of a binominal surd.—The method adopted may be indicated by an example as follows:—

Ex. 2. Extract the square root of $7+4\sqrt{3}$.

Let $\sqrt{x}+\sqrt{y}=\sqrt{(7+4\sqrt{3})}$.

Squaring both sides of the equation we obtain

$$x+y+2\sqrt{xy}=7+4\sqrt{3};$$
$$\therefore\quad x+y=7 \text{ and } 2\sqrt{xy}=4\sqrt{3};$$
$$(x+y)^2=49 \text{ and } 4xy=48.$$

Hence	$x^2+2xy+y^2=49$
and	$4xy=48$
By subtraction	$x^2-2xy+y^2=1$
Thus we find	$x+y=7,$
and	$x-y=1;$
	$\therefore\quad x=4$ and $y=3.$

Hence $\sqrt{(7+4\sqrt{3})}=2+\sqrt{3}$.

That this is the root required is obvious by squaring.

Ex. 3. Reduce $\left(\dfrac{3+\sqrt{5}}{2+\sqrt{5}}\right)^2$ to a form in which the denominator is unity, and find its value as a decimal, having given $\sqrt{5}=2{\cdot}2361$. (1899)

$$\left(\frac{3+\sqrt{5}}{2+\sqrt{5}}\right)^2 \text{ or } \left(\frac{\sqrt{5}+3}{\sqrt{5}+2}\right)^2=\frac{(\sqrt{5}+3)^2(\sqrt{5}-2)^2}{(\sqrt{5}+2)^2(\sqrt{5}-2)^2}$$
$$=\frac{(5+9+6\sqrt{5})(5+4-4\sqrt{5})}{5-4}=\frac{126-2\sqrt{5}-120}{1}$$
$$=6-2\sqrt{5}=1{\cdot}5278.$$

Ex. 4. (*a*) Extract the square root of $15-4\sqrt{14}$.

(*b*) Express the quotient of $10\sqrt{6}-2\sqrt{7}$,

divided by $3\sqrt{6}+2\sqrt{7}$

in its simplest surd form, and find the value of the expression as a decimal, correct to four significant figures.

given $\sqrt{42}=6{\cdot}4807$.

(*c*) Show that

$$\sqrt{(13+3\sqrt{13})}+\sqrt{(13-3\sqrt{13})}=\sqrt{(26+4\sqrt{13})}. \quad (1906)$$

(*a*) Let $\sqrt{x}-\sqrt{y}=\sqrt{15-4\sqrt{14}}$.

Squaring both sides we obtain

$$x+y-2\sqrt{xy}=15-4\sqrt{14}.$$
$$\text{Hence } x+y=15 \quad . \quad . \quad . \quad . \quad \text{(i)}$$
$$\therefore\quad (x+y)^2=225 \quad . \quad . \quad . \quad . \quad \text{(ii)}$$
$$2\sqrt{xy}=4\sqrt{14}$$
$$\text{Squaring } 4xy=16\times14=224 \quad . \quad . \quad . \quad \text{(iii)}$$

Subtracting (iii) from (ii)

$$\therefore\quad (x-y)^2=1, \text{ or } x-y=1.$$

Hence from $x+y=15$, $x-y=1$,

we obtain $x=8$, $y=7$.

$$\therefore\quad \sqrt{15-4\sqrt{14}}=\sqrt{8}-\sqrt{7}.$$

(*b*) $$\frac{10\sqrt{6}-2\sqrt{7}}{3\sqrt{6}+2\sqrt{7}}=\frac{(10\sqrt{6}-2\sqrt{7})(3\sqrt{6}-2\sqrt{7})}{54-28}$$
$$=\frac{152+14\sqrt{42}}{26}=\frac{242{\cdot}7298}{26}$$
$$=9{\cdot}3358.$$

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(c) Let $\sqrt{(26+4\sqrt{13})}=\sqrt{x}+\sqrt{y}$.

Squaring both sides of the equation

$$26+4\sqrt{13}=x+y+2\sqrt{xy}.$$

Hence $x+y=26$; $\therefore (x+y)^2=26^2$ . . (i)

$$2\sqrt{xy}=4\sqrt{13}$$

$$4xy=16\times 13 \quad . \quad . \quad . \quad . \quad \text{(ii)}$$

Subtracting (ii) from (i) we obtain

$$x-y=6\sqrt{13}.$$

Hence $x+y=26$,

$$x-y=6\sqrt{13}.$$

$$\therefore \quad x=\frac{26+6\sqrt{13}}{2}=13+3\sqrt{13}$$

$$y=\frac{26-6\sqrt{13}}{2}=13-3\sqrt{13}.$$

$$\therefore \quad \sqrt{(13+3\sqrt{13})}+\sqrt{(13-3\sqrt{13})}=\sqrt{(26+4\sqrt{13})}.$$

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Light.

The Resolving Power of a Lens.—If the assumptions which form the basis of geometrical optics were absolutely correct (*i.e.* if light travelled exactly in straight lines), a lens would have perfect resolving power whatever might be its aperture. By the term *resolving power*, we mean the capacity of a lens to form distinct and separate images of two very small luminous objects placed close to each other. Let us suppose that a double star is viewed through a telescope; a star is so small in comparison with its distance from the earth that its image formed by a lens would approximate to a geometrical point if the laws of geometrical optics with regard to magnification were fulfilled. Nevertheless when the image of a star is formed by a lens, such as the object glass of a telescope, the image has finite dimensions: the wider the aperture (or transverse breadth) of the object glass, the smaller is the image. This is due to the fact that light is propagated in the form of waves in the ether, and therefore the laws of geometrical optics are only approximately correct. In order that the image of a double star shall be resolved by a lens (*i.e.* in order that the elements of the double star shall form distinct and separate images) it is clear that each image must be so small that it does not overlap the other. We shall now investigate how the size of the image of a star formed by a lens (which is supposed to be free from spherical aberration) depends on the aperture of the lens.

Light radiates from a star in the form of waves; at distances from the star comparable with the distance of the earth, these waves will have acquired the form of spheres of such great radius that they are sensibly plane. (Remember that a small portion of the surface of the earth is sensibly plane, although it is part of a sphere.) Hence we may suppose that plane waves from a star fall on the object glass of a lens, their planes being perpendicular to the axis of the lens. The function of the lens is to retard the central portion of the originally plane waves with respect to their peripheral portions, so that after passing through the lens the waves form spheres with centre at the focus of the lens (see *Light for Students*, p. 315). Thus let ABC (Fig. 1) represent a section of the wave emerging from a lens, and converging toward the point F, which is the focus of the lens. If the surface of which ABC is the section is truly spherical, the lens is not affected by spherical aberration, and is so far perfect; if ABC is not the section of a sphere, spherical aberration is present, and the image will be distorted. We shall suppose that spherical aberration is absent, and therefore that ABC is an arc of a circle, being the section of part of a spherical surface.

The wave surface propagates itself normally, so that its sections at various instants can be obtained by drawing circular arcs with the point F as centre. If this reasoning were

FIG. 1.

precisely accurate, the wave surface would contract until it passed through the geometrical point F, and would then commence to expand; since the wave conveys a definite amount of energy, we should have this, at a particular instant, compressed into the point F, *i.e.* a space with absolutely no dimensions. This is, of course, impossible; hence we may conclude that the wave, as it passes through F, is not confined merely to that point, but that it then has definite dimensions; *i.e.* that the disturbance extends to some distance all round the point F. But the disturbance due to the wave produces the image of the star; hence we see that the image of the star will have a definite size, although it would approximate to a geometrical point if the laws of geometrical optics were exactly true. Let us now suppose that the image of the star extends to a distance FD=x on either side of the point F (Fig. 2). To determine x, we must remember that the disturbance around F is due to the effect of wavelets originating from all points of the surface of which ABC is the section. Let D be a point such that DA is half a wave-length longer than DB, while DB is half a wave-

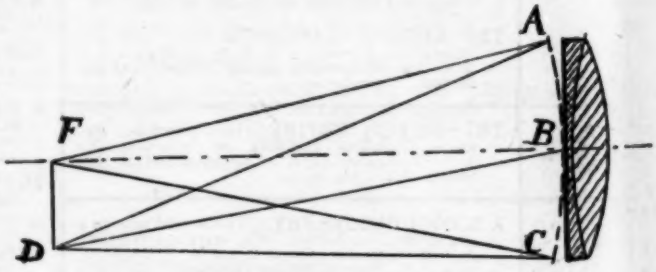

FIG. 2.

length longer than DC. Then the wavelets arriving simultaneously at D from A and B will annul each other; *i.e.* if a crest arrives from the point A, a trough will simultaneously arrive from the point B. Similarly the wavelet arriving from any point between A and B will just be annulled by a wavelet from a point between B and C; in these circumstances the point D will not be subjected to any disturbance (or will be dark), and FD will be the semi-diameter of the image of the star. The point D is determined by the condition that

$$AD-DC=\lambda,$$

where λ is the wave-length of the light.

Let each of the equal angles AFB and BFC be denoted by θ; then remembering that AF=BF=CF=f, the focal length of the lens, we have

$$(AD)^2=(AF)^2+(FD)^2-2AF\,.\,FD\,.\,\cos AFD,$$

$$\therefore \quad (AD)^2=f^2+x^2+2xf\sin\theta \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

since $AFD=AFB+BFD=\left(\theta+\frac{\pi}{2}\right)$, and $\cos\left(\theta+\frac{\pi}{2}\right)=-\sin\theta$.

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Also $(CD)^2=(CF)^2+FD^2-2CF\,.\,FD\,.\cos CFD$,

$$\therefore\quad (CD)^2=f^2+x^2-2xf\sin\theta \quad\ldots\ldots\ldots\ldots (2)$$

since $CFD=BFD-CFB=\left(\frac{\pi}{2}-\theta\right)$, and $\cos\left(\frac{\pi}{2}-\theta\right)=\sin\theta$.

Subtracting (2) from (1), we obtain

$$(AD)^2-(CD)^2=4xf\sin\theta,$$

$$\therefore\ (AD-CD)(AD+CD)=4xf\sin\theta$$

$$AD-CD=\frac{4xf\sin\theta}{AD+CD} \quad\ldots\ldots (3)$$

Now it is clear that we shall commit no appreciable error if we substitute $AD+CD=2f$ in (3), for neither AD nor CD differs from f by so much as λ, the wave-length of light, which varies from 0·0004 mm. to 0·0008 mm.

$$\therefore\ AD-CD=\frac{4xf\sin\theta}{2f}=2x\sin\theta \quad\ldots\ldots (4)$$

Let a be the aperture (*i.e.* the transverse breadth) of the lens, which is practically equal to AC. Then $\sin\theta$ is approximately equal to $\tan\theta$, or to $(a/2)$ divided by f. Thus since $(AD-DC)$ is to be made equal to λ, we have

$$AD-DC=\lambda=2x\,.\,\frac{a}{2f}$$

$$\therefore\ x=\frac{f\lambda}{a}.$$

From this we see that for a given wave-length of light λ, the semi-diameter x of the image of the star is proportional to (f/a). Thus for a lens of given focal length the size of the image of the star will be inversely proportional to a, the aperture of the lens; or the wider the lens is (supposing it to be free from spherical aberration), the smaller will be the image of a star that it produces. At first sight it might appear that we lose by using a lens of wider aperture, since we obtain a smaller image of the star. In reality, however, we gain; for in any case the image obtained with the lens is merely a spot of light, and we cannot hope to discern in it any of the details of the star; by making the image smaller, the light which forms it is more concentrated, and therefore the image is made brighter. Thus it is possible with a good telescope of wide aperture to see stars which are invisible to the naked eye owing to their faintness.

It should be carefully remembered that when a lens forms a true image of an object (*i.e.* under conditions to which the laws of geometrical optics apply) the brightness of the image is independent of the aperture and focal length of the lens, provided that the pencil of rays by which the image is seen is sufficiently wide to fill the pupil (see *Practical Teacher*, June 1906, pp. 657–658).

It must now be pointed out that the image of a star seen in a telescope is not merely a circular spot of light; surrounding it are seen a number of coloured rings. These can be explained as follows:—Take a point (which we may call G) farther away from F than D, the distance of the point G from A being greater than its distance from C by $3\lambda/2$. In this case we may divide ABC into three portions or half-period elements, such that a point in any one portion is half a wave-length farther away from G than the corresponding point in the next portion. In this case the wavelets from two neighbouring portions will annul each other, and the resultant disturbance at G will be due merely to wavelets from the third portion. Thus it may be seen from the above that when

$$\frac{xa}{f}=\frac{3\lambda}{2},$$

we shall have brightness; and as a further generalisation, when xa/f is equal to any odd number of half wave-lengths there will be brightness, since the emergent wave can then be divided into an odd number $(2n+1)$ of half-period elements, of which the $2n$ elements annul each other, while the remaining element sends light to the point in question. On the other hand, if xa/f is equal to an even number $(2n)$ of half wave-lengths, the wavelets from these will totally annul each other at the point at distance x from the centre of the bright central spot. Thus the radii of the bright rings are found by substituting 1, 2, 3, 4, . . . for n in the equation

$$x=\frac{f}{a}\,.\,(2n+1)\,\frac{\lambda}{2}.$$

and the radii of the dark rings are found by substituting 1, 2, 3, 4, . . . for n in the equation

$$x=\frac{f}{a}\,.\,2n\,.\,\frac{\lambda}{2}.$$

We see that the radii of these rings will vary inversely as a, so that the rings become narrower and brighter when a is large. Further, x is proportional to λ, so that the red rings will be larger than the blue rings. Thus the bands surrounding the central spot will be coloured. The central bright spot will be larger for red than for blue rays, so that the appearance presented is as follows:—A central white spot becoming red toward its edges, surrounded by a number of coloured rings of decreasing intensity, the inside of each ring being blue and the outside red. The object glass of a large telescope is adjusted to be perpendicular to the axis of the telescope by arranging it so that these rings appear equally bright all round; when the object glass is out of adjustment, the rings disappear on one side, and are drawn out into a tail on the other.

In conclusion we may now consider the conditions which must be satisfied if a telescope is to resolve a double star. Each component star will produce an image consisting of a bright spot of radius $(f\lambda/a)$. If these two images are not to overlap, but are to just touch each other, then the distance between their centres must be equal to twice the radius of either, or to $(2f\lambda/a)$. Now if we draw two imaginary lines representing rays from the component stars, through the middle point of the object glass, these rays will be undeviated and therefore the centres of the two images will lie on them. Consequently the distance between the centres of the two images will subtend at the middle point of the object glass an angle equal to that which the components of the double star subtend at the same point. Thus if the components of the double star subtend an angle ϕ at the earth, and their images formed by a given object glass of focal length f and aperture a just touch without overlapping, then

$$\phi=\frac{2f\lambda}{a}.$$

This condition will give perfectly clear resolution. If, however,

$$\phi=\frac{f\lambda}{a},$$

it is still possible to see that the star is double; in this case half of one image overlaps half of the other, but the result can be distinguished from a single circular image.

Electricity and Magnetism.

Describe Duddell's oscillograph and the kind of observations that may be made with it.

London University, B.Sc. Pass, 1904.

An **oscillograph** is an instrument for measuring the instantaneous values of an alternating current, *i.e.* of a current which increases, reaches a maximum value, diminishes to zero, and then becomes reversed, and after attaining a maximum value in the new direction, once more falls to zero, and so on. The *period* of the current is the time which elapses between the instant when the current attains a maximum value in one direction, and that when the next maximum value in the same direction is attained. Alternating currents are now used commercially, their periods generally being 1/50 or 1/100 second. If such a current is sent through an ordinary galvanometer, no deflection is produced. When the current for an instant flows in one direction an impulse is imparted to the needle; but before this has moved appreciably the current becomes reversed and the needle suffers an opposite impulse, and so on.

When a battery is suddenly connected to a galvanometer, the needle swings away from its position of rest, and in one quarter of the periodic time of swing of the needle it reaches the position in which it will ultimately come to rest if the current remains constant. The needle does not at once come to rest, however, but swings to and fro across its final position of rest for a length of time which depends on the degree to which the needle is damped.

We thus see that if a needle is to follow the instantaneous values of an alternating current, the following conditions must be realised:—

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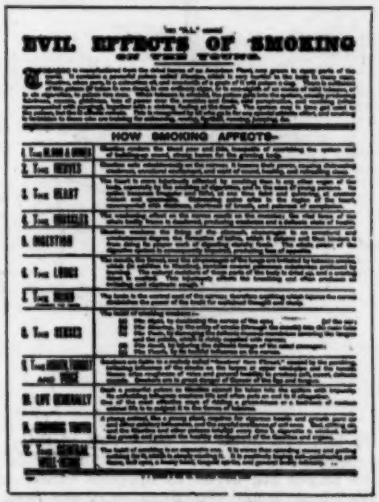

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the current will immediately cause the needle to swing to a new position which it will reach before the current has had time to change appreciably.

(2) *The needle must be damped* to such an extent that it does not swing to and fro across its new position of equilibrium when a constant current is suddenly established through it.

These conditions have been complied with in the oscillograph designed by Mr. Duddell; the general appearance of the instrument can be seen from Fig. 3, while the working parts are

FIG. 3.

shown in Fig. 4. The current to be measured is sent through a thin and narrow strip *s*, *s* (Fig. 4) of phosphor bronze, which is carried over a pulley P, its two halves lying parallel and near to each other in the gap between the poles NS of a powerful electro-magnet. When a current is sent through the strip it

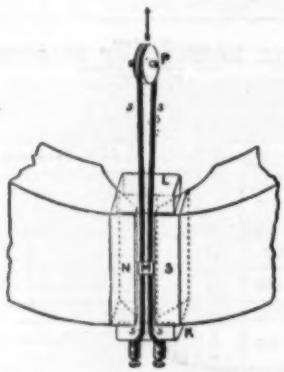

FIG. 4.

flows up one half and down the other half of this; since the strip lies perpendicular to the lines of force of a strong magnetic field, its two halves are urged in opposite directions perpendicular to their lengths and the direction of the lines of force. A small mirror M is attached to the two strips, and is turned about a vertical axis when the strips move in opposite directions. In order that the motion of the strip shall follow the instantaneous values of the current, the period of vibration of the suspended system must be made as small as possible. The number of vibrations per second of either strip is equal to

$$\frac{2}{l}\sqrt{\frac{T}{m_1}},$$

where T is the tension in dynes, m_1 is the mass per unit length, and l is the length of either strip. To make this number as great as possible, T is made large, the pulley P being attached to a species of spring balance by which any required tension may be obtained; since the strip is very narrow and very thin, m_1 is naturally very small. In Mr. Duddell's instrument the strips naturally vibrate about 10,000 times per second.

In order to damp the suspended system, the two portions of the strip are surrounded with a viscous oil where they pass through the space between the poles; hence any variation of the current causes the strips to instantly move up to new positions in which they would remain if the current did not change further.

A beam of light is reflected from the mirror M; when an alternating current is sent through the strips, the mirror rotates to and fro about a vertical axis, and the reflected beam would paint a horizontal straight line on a vertical screen if this were placed in front of the instrument. In practice, however, the beam falls on a mirror which rotates about a horizontal axis perpendicular to the reflected beam; the motion of this mirror by itself would cause the beam of light to trace out a vertical straight line, so that in conjunction with the motion imparted to it by the small suspended mirror M a wavy line is described; this wavy line serves to measure the variation of the current from instant to instant.

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1. Freshly liquefied air, sp. gr. 0·9951; per cent. of oxygen, 58·83.

2. After remaining for several hours, sp. gr. 1·029; per cent. of oxygen, 64·2.

3. After standing for 2–3 days, until most of the nitrogen had evaporated, sp. gr. 1·112; per cent. of oxygen, 93·6.

Using these data, the sp. gr. of a liquid air containing 20·9 per cent. of oxygen, has been calculated and found to be 0·87–0·90.

Liquid oxygen itself has a slightly lower sp. gr., namely, 1·105–1·108, than the mixture (3) containing 93·6 per cent. of oxygen.

The melting-point of ethylene has been found to be −169°, and the boiling-point −105·4° at 760 mm. pressure. The sp. gr. =0·6585 at −169°, and =0·571 at −105·4°.

Liquid Ammonia as a Solvent.—The solubilities of a large number of inorganic and organic compounds in liquid ammonia have been determined. The following is a summary of the results:—

The alkali metals, lithium, sodium, potassium, rubidium, and cæsium, are easily soluble in liquid ammonia, as well as the elements iodine, sulphur, phosphorus, and selenium; copper is slowly acted on by the solvent, especially in presence of air. Metallic fluorides appear to be mostly insoluble, and the same is true of the chlorides of the alkali metals; several of the chlorides of the heavy metals, however, are readily soluble, whilst the chlorides of magnesium, calcium, strontium, barium, zinc, cadmium, manganese, cobalt, nickel, and lead are acted on by liquid ammonia with considerable development of heat, to form insoluble additive products.

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Although the lower alcohols are miscible with liquid ammonia, cetylic alcohol is insoluble; diethylic ether is easily soluble, but diamylic ether dissolves only sparingly. Ethylenic glycol and glycerol are miscible with ammonia, whilst erythritol, dulcitol, and mannitol are only slightly soluble.

The simpler aldehydes and their derivatives, the lower fatty acids and their halogen- and hydroxy-substituted products, and the ethereal salts, are easily soluble, although the solubility decreases in each series with increasing molecular weight. Dibasic acids and their hydroxy-derivatives are very sparingly soluble, whilst the sugars, nitriles, cyanates, thiocyanates, amines, amido-acids, acidamides, and ureides are generally readily soluble. Aromatic hydrocarbons and halogen derivatives are, as a rule, only slightly soluble in liquid ammonia, although benzene is dissolved to the extent of 10 per cent.; the nitro-derivatives of the hydrocarbons are moderately soluble, whilst most amido-derivatives dissolve very readily, although the secondary and tertiary aromatic amines are only slightly soluble. The phenols and their ethers, together with their substituted derivatives, the aromatic alcohols, aldehydes, acids, substituted acids, sulphonic acids, ethereal salts, and acid amides and anilides, are all easily soluble. The dibasic acids are, however, insoluble, and the same is true of derivatives of the terpenes; naphthalene and isoquinoline are slightly soluble, whilst the naphthols, naphthylamines, pyridine, and quinoline are easily soluble.

Benzene, metaxylene, triphenylmethane, naphthalene, chloro- and iodo-benzene, dibromobenzene, and parahydroxybenzoic acid, which are all very slightly soluble in liquid ammonia at $-38°$, are easily soluble at 25°. Anthracene, pinene, stearic acid, cadmium iodide, and potassium chromate are, however, insoluble, whilst phthalic and succinic acids are disintegrated at 25° and their ammonium salts formed, although these remain undissolved.

Electrolysis of Solutions of Zinc Chloride.—A perfectly neutral solution of zinc chloride containing 54·6 grams of zinc per litre was electrolysed with a cathodic current density of 1·4 ampères per square decimetre. The anode consisted of pure electrolytic zinc. For several hours the deposit consisted of smooth light-grey zinc; after twenty hours the solution became turbid owing to the separation of zinc oxychloride, and zinc sponge was deposited. The solution then contained 1 molecule of ZnO to 14 $ZnCl_2$.

By using a small subsidiary platinum anode, a small quantity of chlorine was continuously supplied to the solution; this did not, however, prevent the formation of the sponge. Zinc chloride solutions, whether acid or alkaline originally, always become basic after a time, owing to the energetic oxidation of the zinc electrodes by atmospheric oxygen in presence of zinc chloride, and the formation of the zinc sponge always begins when the solution is saturated with zinc oxide.

From a solution containing 1/20 to 1/30 gram-molecule of hydrochloric acid per litre, zinc may be deposited in any quantity without the spongy deposit appearing. Under these circumstances, some hydrogen is evolved, the bubbles of which remain persistently attached to the cathode, producing unevenness in the deposit. The presence of a little free chlorine (0·2 gram per litre) is useful in preventing this prolonged adherence to the same point. By this method, perfect deposits of zinc, quite free from arsenic, were also obtained when impure zinc anodes were used.

It has been shown in detail that all definitely ascertained facts relating to the formation of spongy zinc point to the conclusion that it is produced whenever the condition of the solution at the cathode is such that basic zinc salts or zinc hydroxide may separate out there.

Action of Reagents on Aluminium.—Alfred Ditte has investigated the action of various solutions of aluminium. It is generally believed that aluminium is not attacked by water or dilute acids, but this result is really due to the formation, at the surface of the metal, of a layer of gas which adheres strongly and prevents further access of the liquid. If this layer of gas is removed by mechanical means, or if the action takes place in a vacuum, the aluminium is completely dissolved by acetic, citric, oxalic, tartaric, and other acids. Similarly, the resistance of the metal to the action of solutions of salts, such as the halogen salts of the alkalies, which should attack it with considerable development of heat, is due to the formation of a protective film of aluminium hydroxide.

If a small quantity of a dilute acid is added, the oxide is dissolved and the action of the saline solution continues. A mixture of sodium chloride solution and dilute acetic acid, for example, will dissolve aluminium so long as any free acid remains, although neither the acid nor the saline solution would attack the metal more than superficially. Halogen salts of calcium and magnesia behave similarly. Alkali carbonates dissolve aluminium almost as readily as alkali hydroxides; hydrogen is liberated and an alkali aluminate and a hydrogen carbonate are formed. Ammonia solution, concentrated or dilute, also attacks the metal so long as the aluminate dissolves in the excess of alkali, but the action ceases when a film of the aluminate begins to form on the metal.

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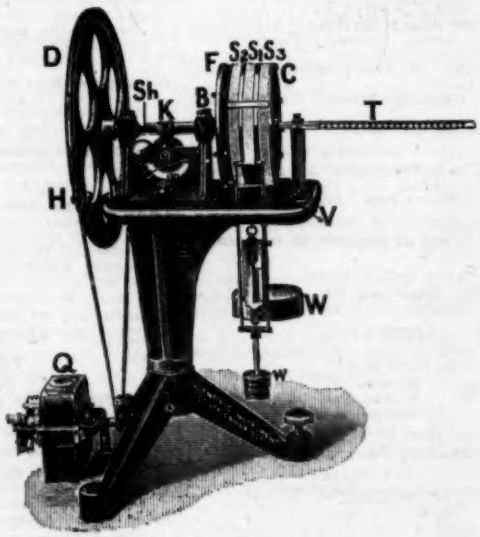
The apparatus is illustrated in the accompanying figure. Sh is a shaft running in bearings B. This carries at one end a



driving-wheel D, which may be driven by means of the handle H, or by means of a cord from the motor Q. In the centre of

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the shaft is a worm K, working into a worm-wheel which has one hundred teeth, so that it makes one revolution to one hundred made by the shaft.

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To the other end of the shaft is attached a face-plate F, which rotates with it.

This face-plate carries a hollow cylinder C, made of thin brass. The cylinder is completely closed except for a central hole about an inch in diameter. Through this hole passes a mercury thermometer T. The thermometer is supported on a bracket as shown in the figure, and is bent at right angles inside the cylinder, so that the bulb reaches nearly to the circumference of the cylinder. The cylinder is bolted to the face-plate by means of nuts and small brass rods passing through both. The holes in the face-plate through which the rods pass are brushed with ivory to prevent any appreciable amount of heat passing from the cylinder to the face-plate during an experiment.

The rods are soldered into the cylinder so that water will not leak through the holes. Round the cylinder is a white silk band S, from one end of which hangs a rectangular frame with a rod on which small slotted weights w may be supported.

The other end of this band is attached to a strip of vulcanised fibre V, so that this band is in contact with the cylinder for about three-quarters of a complete turn. Also attached to the same piece of fibre are two other silk bands, S_2 and S_3, which also pass round the cylinder for about three-quarters of a complete turn, and jointly are attached to a rod carrying a large weight W.

When the wheel D is turned so that the cylinder is rotated in such a direction as to tend to lift the large weight W, there is a considerable amount of friction between the cylinder and the silk bands, and if the speed is sufficiently great the weight W is actually lifted by the combined influences of the weights w and the friction. By adjusting the velocity with which the drum rotates, the weight W can be kept suspended in this way. It is, however, a difficult matter to hit this off exactly, as the friction is liable to vary on different parts of the cylinder, and it is also difficult to keep the velocity quite constant. To get over this difficulty, a small spring-balance b is attached at its lower end to the cross-piece of the frame carrying the small weights w. At its upper end it is attached to the stand of the instrument. The effect of this small spring-balance is like that of a buffer. It prevents the weights swinging up and down so much with slight variations in the friction. At the same time, the pull exerted by the weights w on the spring of the balance can be read off in grams.

If we know the mass of the weight W, and also the masses of the smaller weights w, and the frame supporting them, as well as the pull on the balance b, we can tell what is the influence of the friction of the belt.

The pull exerted by the large weight is Wg, where W is the mass in grams and g the force of gravity in dynes.

The pull on the other side is the pull of the weights w + the pull due to the frame, less that on the balance. Let the mass of the frame be m_1, and the reading on the balance m_2, then the pull on this side is

$$(w + m_1 - m_2)g.$$

The difference in the pulls on the two sides then is

$$\{W - (w + m_1 - m_2)\}g \text{ dynes}$$

$$= (W - w - m_1 + m_2)g \text{ dynes.}$$

This is, of course, counterbalanced by the friction on the surface of the cylinder. The work done, then, on the surface of the cylinder is the product of this force into the distance the surface of the cylinder has moved through.

The surface of the cylinder moves through πd centimetres per revolution, where d is the diameter in centimetres. In n revolutions the distance moved through is $n\pi d$. Hence the work done on the cylinder in n revolutions in ergs is

$$(W - w + m_1 - m_2)g \times \quad n\pi d,$$

i.e. Force × distance.

This energy expended in overcoming friction is converted into heat.

In an actual experiment the heat produced is measured in the following way. A quantity of water, whose weight is known in grams, is introduced into the cylinder through the central hole. The quantity of water should be such as to fill the cylinder not more than one-third full. Let m_3 be the mass of the water in grams. Also let m_4 be the water equivalent of the cylinder (see note). Let us represent the sum of these two by M.

When the cylinder is rotated the temperature rises, and the rise in temperature is noted on the thermometer T.

Let the rise in temperature in n revolutions be $(t_2 - t_1)$, where t_1 is the initial temperature and t_2 the final temperature. Then the heat produced in n revolutions will be $M(t_2 - t_1)$.

This heat is produced by the expenditure of

$$(W - w + m_1 - m_2)g\ n\pi d \text{ units of work;}$$

therefore one unit of heat is produced by the expenditure of

$$\frac{(W - w + m_1 - m_2)g\ n\pi d}{M(t_2 - t_1)} \text{ units of work.}$$

This quantity therefore represents the *Mechanical Equivalent of Heat*. Suitable weights to use in this experiment are about four kilogrammes on one side and half a kilogramme on the other.

If the initial temperature of the water is arranged so as to be about 10° C. below the temperature of the room, and the experiment is stopped when the temperature has risen to the same number of degrees above the temperature of the room, no correction need be made for loss by radiation.

With this apparatus a rise of two degrees per minute can easily be obtained, and in about ten minutes a result accurate to within about ½ per cent. can be obtained.

Note.—The water equivalent of the cylinder is obtained in the same way as the water equivalent of an ordinary calorimeter is obtained. The thermometer is left inside for some time, and the temperature is then read A jacketed vessel of warm water is weighed, its temperature taken, some of the warm water poured into the cylinder, and the cylinder rotated several times with no weights on. It becomes of the same temperature as the water. The weight of the water is obtained by again weighing the jacketed vessel and subtracting this weight from the former weight. The fall in temperature of the water multiplied by its mass gives the amount of heat lost by the warm water to the cylinder. This divided by the rise in temperature of the cylinder gives the quantity of heat required to raise its temperature by one degree. This is the water equivalent of the cylinder.

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THE position of religious instruction in non-provided or denominational schools is seriously affected by a judgment given by the Court of Appeal on 8th August. The West Riding County Council, who are the education authority in that area of Yorkshire, took up the attitude that they were under no obligation to pay for the religious instruction given by the teachers in non-provided schools during school hours. Accordingly, they deducted from the salaries of the teachers a proportion estimated to represent the time devoted by them to this purpose. All other education authorities—including London—have paid the full salaries without demur; and the interpretation placed upon the Act of 1902 by the Education Board at Whitehall, being that such a deduction could not be made, they sought a mandamus to compel the West Riding Council to fall into line. By a majority of two to one—Lord Justice Moulton dissenting—the Court of Appeal have now ruled that local education authorities are not required to pay the teachers out of the rates for the religious instruction given to the children in the non-provided schools—a decision which must unquestionably gravely affect the status of such teaching all over the country.

Briefly put, the ground upon which the Master of the Rolls based his judgment, which was supported by Lord Justice Farwell, was that the duty cast upon local education authorities to "maintain and keep efficient" public elementary schools does not embrace the denominational religious instruction given within them, because control in this matter is expressly taken from the education authorities, and they are, therefore, not in a position to secure efficiency in the religious teaching.

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Bike.—The line $Ax+By=C$ is a normal to the curve $a^{n-1}y=x^n$. Prove that

$$n^nA^nC^{n-1}=a^{n-1}B(nA^2+B^2)^{n-1}.$$

The normal to the curve $f(x, y)=0$ at any point (x, y) on the curve is

$$\frac{X-x}{\frac{\delta f}{\delta x}}=\frac{Y-y}{\frac{\delta f}{\delta y}},$$

where X, Y are the current co-ordinates of any point on the normal. Hence the normal to the given curve at any point (x, y) on the curve is

$$\frac{X-x}{nx^{n-1}}+\frac{Y-y}{a^{n-1}}=0.$$

Comparing this with the given line

$$AX+BY=C,$$

we find that $a^{n-1}=A$, $nx^{n-1}=B$, and $a^{n-1}x+nx^{n-1}y=C$.

But from the equation of the curve we have

$$y=\frac{x^n}{a^{n-1}}.$$

$$\therefore\quad Ax+\frac{nx^{2n-1}}{A}=C;$$

$$\therefore\quad x(A^2+nx^{2n-2})=AC \quad . \quad . \quad . \quad . \quad (1)$$

But we have seen that $nx^{n-1}=B$;

$$\therefore\quad x=\left(\frac{B}{n}\right)^{\frac{1}{n-1}}, \text{ and } nx^{2n-2}=\frac{B^2}{n}.$$

Hence (1) may be written

$$\left(\frac{B}{n}\right)^{\frac{1}{n-1}}(nA^2+B^2)=nAC;$$

$$\therefore\quad \frac{B}{n}(nA^2+B^2)^{n-1}=n^{n-1}A^{n-1}C^{n-1};$$

$$\therefore\quad AB(nA^2+B^2)^{n-1}=n^nA^nC^{n-1};$$

$$\therefore\quad n^nA^nC^{n-1}=a^{n-1}B(nA^2+B^2)^{n-1}.$$

W. H. H.—The chord QQ^1 of a conic subtends a constant angle at the focus S. Show that it touches another conic with the same focus and directrix.

If we reciprocate with regard to a circle having its centre at S we have the following theorem:—

If tangents to a circle intersect at a constant angle the locus of their intersection is a concentric circle. This is obviously true; hence the reciprocal theorem is proved.

Scamp. Solve $3-4\cos^2\theta=\tan\theta$

$$3-4\cos^2\theta=\frac{\sqrt{1-\cos^2\theta}}{\cos\theta}$$

$$(3-4\cos^2\theta)^2=\frac{1-\cos^2\theta}{\cos^2\theta}.$$

Put $x=\cos^2\theta$.

Then $$(3-4x)^2=\frac{1-x}{x};$$

$$\therefore\quad (9-24x+16x^2)x=1-x;$$

$$\therefore\quad 16x^3-24x^2+10x-1=0;$$

$$\therefore\quad (2x-1)(8x^2-8x+1)=0;$$

$$\therefore\quad x=\tfrac{1}{2} \text{ or } \frac{2\pm\sqrt{2}}{4};$$

$$\therefore\quad \cos^2\theta=\tfrac{1}{2} \text{ or } \frac{2\pm\sqrt{2}}{4}.$$

But $\cos^2\frac{\pi}{4}=\frac{1}{2}$, and $\cos^2\frac{\pi}{8}=\frac{2+\sqrt{2}}{4}$, and $\cos^2\frac{3\pi}{8}=\frac{2-\sqrt{2}}{4}$;

$$\therefore\quad \theta=2n\pi\pm\frac{\pi}{4},\ 2n\pi\pm\frac{3\pi}{4};\ 2n\pi\pm\frac{\pi}{8},\ 2n\pi\pm\frac{7\pi}{8};$$

$2n\pi\pm\frac{3\pi}{8}$, $2n\pi\pm\frac{5\pi}{8}$; where n is zero or any integer positive or negative.

Student.—Show how to replace a force whose line of action meets the plane of the triangle ABC in any point O by three parallel forces whose lines of action pass through A, B, C respectively.

A heavy uniform triangular plate, of weight W, rests horizontally on three pegs at the middle points of its sides. Find the condition that a weight w, placed on the plate, may never upset it, whatever its position; and assuming this condition satisfied, find the change it produces in the pressures on the pegs when it is placed at one of the corners of the triangle.

(Inter. Science, London, 1905.)

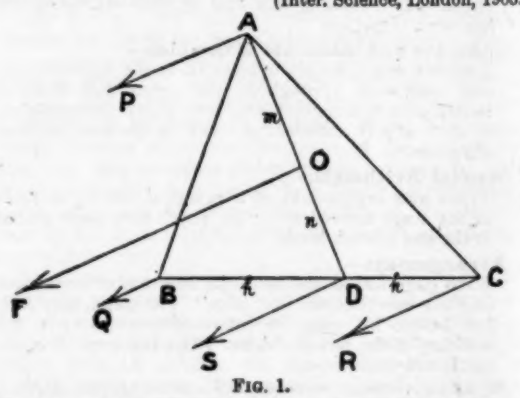

FIG. 1.

Referring to Fig. 1, join AO, and let AO meet BC or BC produced, in the point D. Denote the length of AO by m, that of OD by n, that of DB by k, and that of DC by k. At A and D

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apply the forces P and S parallel to the given force F, and such that $P=\frac{n}{m+n}F$ and $S=\frac{m}{m+n}F$. Then F may be replaced by P and S.

At B and C apply the forces Q and R parallel to S, and such that $Q=\frac{k}{h+k}S$, and $R=\frac{h}{h+k}S$. Then S may be replaced by the forces Q and R. Thus the force F is replaced by the three forces, P, Q and R, each parallel to F, and such that $P=\frac{n}{m+n}.F$, $Q=\frac{km}{(h+k)(m+n)}.F$, and $R=\frac{hm}{(h+k)(m+n)}.F$.

Referring to Fig. 2, let ABC represent the given plate. Then if D, E, F are the middle points of the sides, the centre of

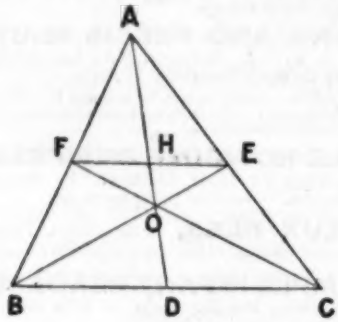

FIG. 2.

gravity is at O, the intersection of AD, BE, CF. Let FE cut AD in H. Then denoting the length of AD by l, we have $AO=\frac{2}{3}l$, and $AH=\frac{1}{2}l$. Hence $OH=\frac{1}{6}l$. Now suppose w is such that when placed at A it just upsets the plate. Taking moments about FE we have

$$w.\frac{l}{2}=W\frac{l}{6}.$$

Hence $$w=\frac{W}{3}.$$

Therefore the required condition is that w shall not be greater than $\frac{W}{3}$.

This condition being supposed satisfied, let w be placed at A. Let P, Q, R be the pressures on the pegs at D, E, F. Taking moments about FE, we have

$$w.\frac{h}{2}=W.\frac{h}{6}-P.\frac{h}{2}.$$

$$\therefore\ P=\frac{W}{3}-w.$$

But $$P+Q+R=W+w.$$

Hence $$Q+R=W+w-\left(\frac{W}{3}-w\right)=\frac{2W}{3}+2w.$$

Taking moments about AD, we have Q=R.

$$\therefore\ P=\frac{W}{3}-w,\ Q=\frac{W}{3}+w,\text{ and }R=\frac{W}{3}+w.$$

Stradivarius.—In a triangle ABC, if the base BC be divided at X so that $mBX=nXC$, show that $mAB^2+nAC^2=mBX^2+nXC^2+(m+n)AX^2$.

Draw AN perpendicular to BC. Then by Euclid II., 12 and 13, we have

$$mAB^2=m(BX^2+XA^2+2BX\,.\,XN)$$
$$nAC^2=n(CX^2+XA^2-2CX\,.\,XN)$$

But $mBX=nCX$, therefore

$$m(2BX\,.\,XN)=n(2CX\,.\,XN).$$

Hence on addition we have

$$mAB^2+nAC^2=mBX^2+nCX^2+(m+n)XA^2.$$

C. W.—If $(a+b+c)^3=a^3+b^3+c^3$, show that when n is a positive integer, $(a+b+c)^{2n+1}=a^{2n+1}+b^{2n+1}+c^{2n+1}$.

(Hall and Knight's *Higher Algebra.*)

$$(a+b+c)^3=a^3+b^3+c^3+3(a+b)(b+c)(c+a).$$

Therefore by the data of question, $3(a+b)(b+c)(c+a)=0$.

Hence $a+b=0$, or $b+c=0$, or $c+a=0$.

The postulated relation holds when $a+b=0$, since either side then reduces to c^{2n+1}. Similarly it holds when $b+c=0$, and also when $c+a=0$. Therefore if $(a+b+c)^3=a^3+b^3+c^3$, then when n is a positive integer, $(a+b+c)^{2n+1}=a^{2n+1}+b^{2n+1}+c^{2n+1}$.

Weon.—Please solve the following by the Calculus:—If V is the velocity of a simple pendulum at its lowest point, show that at any time, t, after passing through the lowest point, its velocity is $V\cos\frac{2\pi t}{T}$, where T denotes the time of one complete oscillation.

Let l denote the length of the string, and θ the angle the string makes with the vertical t seconds after the bob has last passed through the lowest point.

Then the acceleration in the direction of motion $=\frac{ld^2\theta}{dt^2}$. But this is also $=-g\sin\theta,=-g\theta$ approximately for a small oscillation;

$$\therefore\ \frac{d^2\theta}{dt^2}+\frac{g}{l}\theta=0;$$

$$\therefore\ \left(\frac{d\theta}{dt}\right)\frac{d^2\theta}{dt^2}+\frac{g}{l}\theta\left(\frac{d\theta}{dt}\right)=0.$$

Integrate with respect to t.

$$\therefore\ \tfrac{1}{2}\left(\frac{d\theta}{dt}\right)^2+\tfrac{1}{2}\frac{g}{l}\theta^2=C.$$

When $\theta=0$, $\frac{d\theta}{dt}=\frac{V}{l}$, $\therefore\ C=\frac{1}{2}\frac{V^2}{l^2}$;

$$\therefore\ \tfrac{1}{2}\left(\frac{d\theta}{dt}\right)^2+\tfrac{1}{2}\frac{g}{l}\theta^2=\tfrac{1}{2}\frac{V^2}{l^2};$$

$$\therefore\ \left(\frac{d\theta}{dt}\right)^2=\frac{g}{l}\left(\frac{V^2}{gl}-\theta^2\right);$$

$$\therefore\ \frac{dt}{d\theta}=\pm\frac{l}{g}\frac{1}{\sqrt{\frac{V^2}{gl}-\theta^2}};$$

$$\therefore\ \theta=\frac{V}{\sqrt{gl}}\sin\left(\sqrt{\frac{g}{l}}.t+\beta\right)\quad\ldots\quad(1)$$

where β is a constant of integration.

When $t=0$, $\theta=0$;

$$\therefore\ (1)\text{ becomes }\theta=\frac{V}{\sqrt{gl}}\sin\sqrt{\frac{g}{l}}.t\quad\ldots\quad(2)$$

If v be the velocity in the direction of motion at the time t,

$$v=l\frac{d\theta}{dt}.$$

Then from (2) we have

$$v=l\sqrt{\frac{g}{l}}.\frac{V}{\sqrt{gl}}.\cos\sqrt{\frac{g}{l}}t;$$

$$\therefore\ v=V\cos\sqrt{\frac{g}{l}}t\quad\ldots\quad(3)$$

If T be the time of a complete oscillation, θ and $\frac{d\theta}{dt}$ repeat at $t+T$.

$$\left.\begin{aligned}\therefore\ \sin\sqrt{\frac{g}{l}}(t+T)&=\sin\sqrt{\frac{g}{l}}t\\ \cos\sqrt{\frac{g}{l}}(t+T)&=\cos\sqrt{\frac{g}{l}}t\end{aligned}\right\}$$

$$\therefore\ \sqrt{\frac{g}{l}}T=2\pi;$$

$$\therefore\ \sqrt{\frac{g}{l}}=\frac{2\pi}{T}.$$

Thus from (3) we have

$$v=V\cos\left(\frac{2\pi}{T}t\right).$$

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